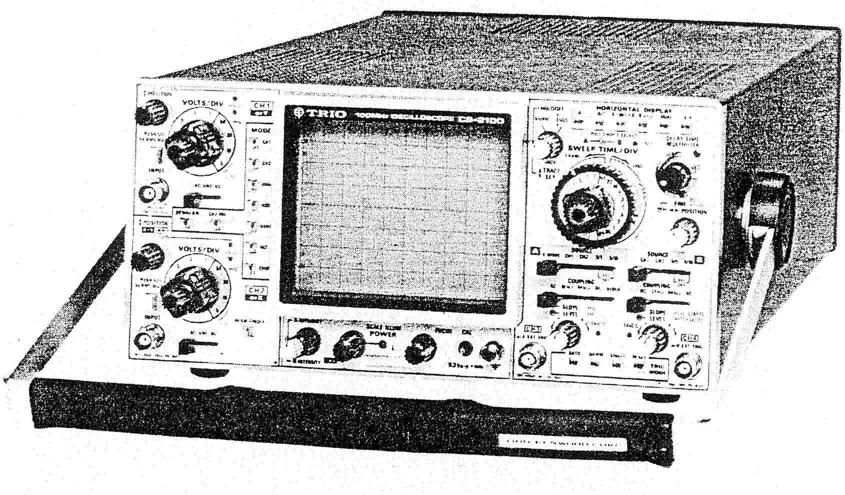
DELAYED SWEEP OSCILLOSCOPE

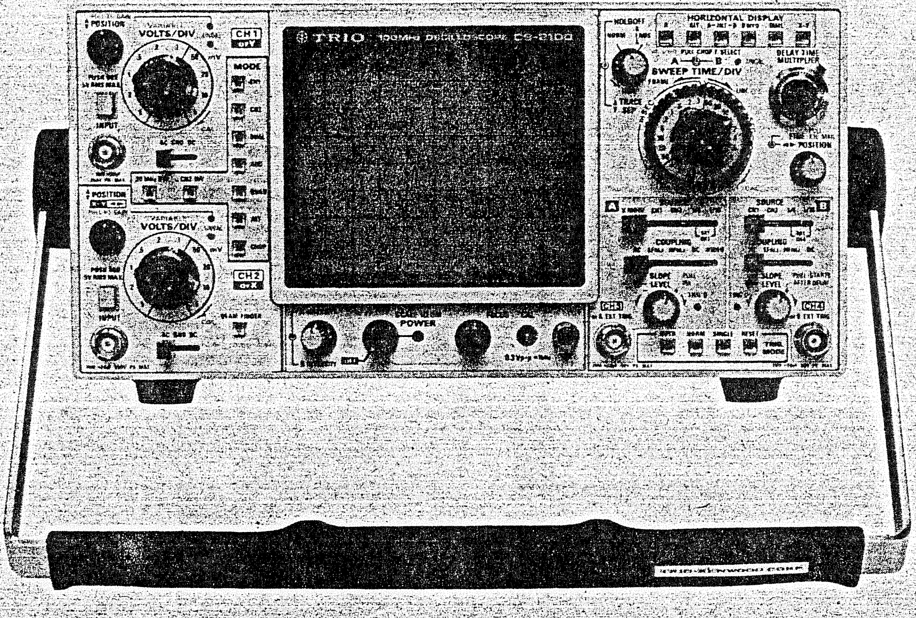
CS-2100

100MHz 4-CHANNEL OSCILLOSCOPE



TRIO

SERVICE MANUAL


TRIO 100MHz OSCILLOSCOPE CS-2100
VOLTS/DIV
CH1
CH2
MODE
POSITION
INPUT
POWER
HORIZONTAL DISPLAY
SWEEP TIME/DIV
DELAY TIME MULTIPLIER
HOLDOFF
COUPLING
SOURCE
SLOPE
LEVEL
TRIO-KENWOOD CORP.

Serial Number 1060001 ~ 2020200

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FEATURES

- Small and compact with high 5 mV/div sensitivity and 100 MHz bandwidth (1 mV/div when X5 GAIN function is used and 500 μV/div for cascaded operation, CH1 to CH2).
- Bright 150 mm rectangular CRT with an internal graticule and a 16 kV accelerating potential.
- Vertical axis is capable of single, dual as well as 4-trace display.
- Dual sweep with independent A and B sweeps is provided in addition to single sweep, X10 magnification, delayed sweep and alternating sweep capability.
- Fast 20ns/div sweep speed (2ns/div with X10 magnification).
- A switching type power supply provides stable operation with varying power sources.
- A convenient channel 1 sampling output is provided.
- Gate signal outputs for both A Sweep and B Sweep are provided for use in synchronizing peripheral equipment to these sweeps.
- A convenient beam finder allows you to quickly locate elusive traces.
- Logic controlled switching with LED lighted pushbutton switches provides easy, reliable switching with setting hold capability when the instrument is switched off.

SPECIFICATIONS

CRT

Model:	150ATM31A
Display area:	8 × 10 div (1 div = 1 cm)
Type:	Rectangular, with internal graticule
Accelerating potential:	16kV

VERTICAL AXIS (Channel 1 and Channel 2 identical specifications)

Sensitivity:	5 mV/div to 5V/div (X1 mode) 1 mV/div to 1V/div (X5 mode) 500 μV/div (Cascaded operation, CH1 to CH2)
Accuracy:	±3% (10 ~ 35°C) ±5% (0 ~ 50°C) ±8% (Cascaded operation, CH1 to CH2)
Attenuator:	5 mV/div to 5V/div in 1-2-5 sequence, all 10 ranges with fine adjustment.
Input resistance:	1 MΩ ±2% (1 MΩ mode) 50Ω ±2% (50Ω mode)
Input capacitance:	Approx. 28pF
Frequency response:	(Include × 5 GAIN mode)
DC:	DC to 100 MHz (−3 dB) DC to 120 MHz (−6 dB) DC to 70 MHz (−3 dB), (Cascaded operation, CH1 to CH2)
AC:	5 Hz to 100 MHz (−3 dB) 5 Hz to 120 MHz (−6 dB) 7 Hz to 70 MHz (−3 dB), (Cascaded operation, CH1, to CH2)
Risetime:	3.5ns
Signal delay time:	Approx 30ns as displayed on CRT screen
Crosstalk:	−40 dB minimum
Operating modes:	
CH1	CH1, single trace
CH2	CH2, single trace
DUAL	CH1 and CH2, dual trace
ADD	CH1 + CH2 (added) display
QUAD	CH1 ~ CH4, four trace
ALT	Two or four waveforms, alternating
CHOP	Two or four waveforms, chopped
CHOP frequency:	Approx 250 kHz, switchable
Polarity reversal:	CH2 only
Maximum input voltage:	500 Vp-p or 250V (DC + AC peak) in 1 MΩ mode. 5 Vrms or DC ±5V in 50Ω mode.
Maximum undistorted amplitude.	8 division, minimum (DC to 100 MHz)
Bandwidth limiting:	Vertical system bandwidth with the 20 MHz BW pushbutton switch pushed is approximately 20 MHz

VERTICAL AXIS (Channel 3 and Channel 4 common specifications)

Sensitivity:	0.1V/div, 1V/div ±3%
Attenuator:	1/1, 1/10
Input resistance:	1 MΩ ±2%
Input capacitance:	Approx. 28 pF
Input coupling mode:	DC only
Frequency response:	DC to 100 MHz (−3 dB) DC to 120 MHz (−6 dB)
Risetime:	3.5ns
Signal delay time:	Same as CH1 and CH2
Maximum allowable voltage	
DC component:	±0.5V or less (AC + DC) (±5V, 1/10 attenuated)
AC component:	1 Vp-p (10 Vp-p, 1/10 attenuated) or less
Maximum input voltage:	50V (DC + AC peak)

HORIZONTAL AXIS (CH2 input)

Modes:	X-Y mode is switch selectable (HORIZONTAL DISPLAY)
X-Y mode:	CH1: Y-axis CH2: X-axis
Sensitivity:	Same as CH2
Accuracy:	Same as CH2
Input resistance:	Same as CH2
Input capacitance:	Same as CH2
Frequency response:	
DC:	DC to 5 MHz (−3 dB) DC to 6 MHz (−6 dB)
AC:	5 Hz to 5 MHz (−3 dB) 5 Hz to 6 MHz (−6 dB)
X-Y phase difference:	Less than 3° at 100 kHz

SWEEP

Modes (switchable with the HORIZONTAL DISPLAY switch):

A	A Sweep
ALT	B Sweep waveform is displayed as an intensified portion of the A Sweep and B Sweep alternating
A-INT-B	Duration of the B Sweep is displayed as an intensified portion of the A Sweep.
B DLY'D	Delayed B sweep
DUAL	Dual sweep — A and B sweeps, in dependently
X-Y	X-Y display mode

SPECIFICATIONS

A Sweep time: 20ns/div to 0.5s/div in 23 ranges, in 1-2-5 sequence, verninier control provides fully adjustable sweep time between steps.

B Sweep time: 20ns/div to 50ms/div in 20 ranges, in 1-2-5 sequence.

Accuracy: ±3% (10 ~ 35 °C)
±6% (0 ~ 50 °C)

Sweep magnification: X10 ±5% (10 ~ 35 °C)
±7% (0 ~ 50 °C)

Linearity: 20ns/div to 0.5s/div ±3%
(±5% with X10 magnification)

HOLDOFF: Continuously adjustable for A Sweep hold off time from NORM to X10.

Trace separation: B positionable up to 4 divisions separated from A Sweep, continuously adjustable.

Delay method: Continuous delay, SYNC delay

Delay time: 0.2 to 10 times the sweep time from 200ns to 0.5s, continuously adjustable.

Time difference measurement accuracy:
±2% (10 ~ 35 °C)
±4% (0 ~ 50 °C)

Delay jitter: 1/20000 of the full scale sweep time.

TRIGGERING

A TRIG

A trigger modes: AUTO, NORM, SINGLE,
FIX: at the center of the waveform

Trigger source: V MODE, CH1, CH2, (EXT) CH3 1/1 and 1/10

Coupling modes: AC, LF$_{REJ}$, HF$_{REJ}$, DC, VIDEO
VIDEO-LINE sync automatically selected at sweep times of 50 μs/div to 20ns/div.
VIDEO-FRAME sync automatically selected at sweep times of 0.5s/div to 0.1ms/div.

Trigger level: ±90° adjustable

Polarity: +/−

B TRIG

B trigger modes: STARTS AFTER DELAY,
TRIGGERABLE AFTER DELAY

Trigger source: CH1, CH2, (EXT) CH4 1/1 and 1/10

Coupling modes: AC, LF$_{REJ}$, HF$_{REJ}$, DC

Trigger level: ±90° adjustable

Polarity: +/−

Trigger sensitivity (A and B)

COUPLING	FREQ RANGE	MINIMUM SYNC AMPLITUDE		
		INT	EXT	EXT 1/10
DC	DC ~ 20 MHz DC ~ 50 MHz DC ~ 100 MHz	0.5div 1.0div 1.5div	50 mV 100 mV 150 mV	0.5V 1.0V 1.5V
AC	Same as for DC but with increased minimum level for below 20 Hz			
AC HF$_{REJ}$	Increased minimum level below 20 Hz and above 30 kHz			
AC LF$_{REJ}$	Increased minimum level below 30 kHz			
VIDEO	FRAME LINE	0.5div	50 mV	0.5V

AUTO: Same as above specifications for above 30 Hz.

FIX: 40 Hz∿20 MHz 0.5 div (50 mV)
40 Hz∿80 MHz 1.5 div (150 mV)

Jitter: 0.5ns maximum at 100 MHz at 2ns/div sweep rate (X10 MAG on)

CALIBRATING VOLTAGE AND CURRENT

1 kHz ±3% Positive square wave
0.3V ±1% (10 ~ 35 °C)
±2% (0 ~ 50 °C)
10 mA ±2% (10 ~ 35 °C)
±4% (0 ~ 50 °C)

INTENSITY MODULATION

Input signal: TTL level, intensity increasing with more positive levels

Input impedance: Approx. 10 kΩ

Usable frequency range: DC to 10 MHz

Maximum input voltage: 50V (DC + AC peak)

VERTICAL AXIS OUTPUT

Sampled CH1 output

Output voltage: 50 mVp-p/div (into 50Ω load)

Output impedance: Approx. 50Ω

Frequency response: DC to 100 MHz (−3 dB) (into 50Ω load)

GATE OUTPUT (A and B)

Output voltage: Approx. 1.5V positive gate (into 500Ω load)

TRACE ROTATION

Electrical, adjustable

POWER SUPPLY

Line voltage: LOW: 90 ~ 132V
HIGH: 180 ~ 264V

Line frequency: 50/60 Hz

Power consumption: Approx. 56W

DIMENSIONS

Width: 284 mm (328 mm)

Height: 138 mm (150 mm)

Depth: 400 mm (471 mm)

( ) dimensions include protrusions from basic case outline dimensions.

SPECIFICATIONS

WEIGHT 7.4 kg

ACCESSORIES

PC-29 Probes	2
Instruction Manual	1
Hand Book	1
AC power cord	1
Panel Cover	1
Probe holder	1

OPTION

Accessory Bag (MC-78)

ENVIRONMENT

Operating temperature and humidity for guaranteed specifications:	10 ~ 35°C, 85% maximum RH
Full operating range:	0 ~ 50°C, 90% maximum RH
Storage temperature and humidity range:	−20° ~ 55°C 80% maximum
Altitude:	
Operating:	5000 m
Non-operating:	12000 m

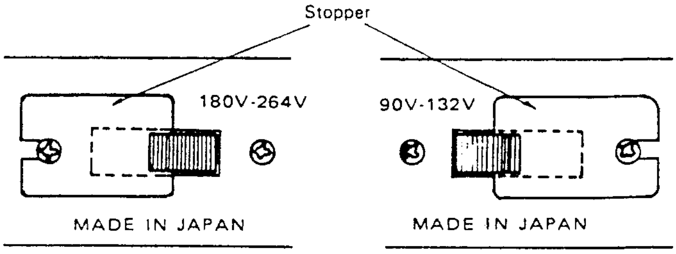
PRECAUTIONS FOR USE

CAUTION:

Before applying power to the CS-2100 be sure that the Line Voltage Switch is set to the proper voltage. If this is not done damage to the power supply unit could result.

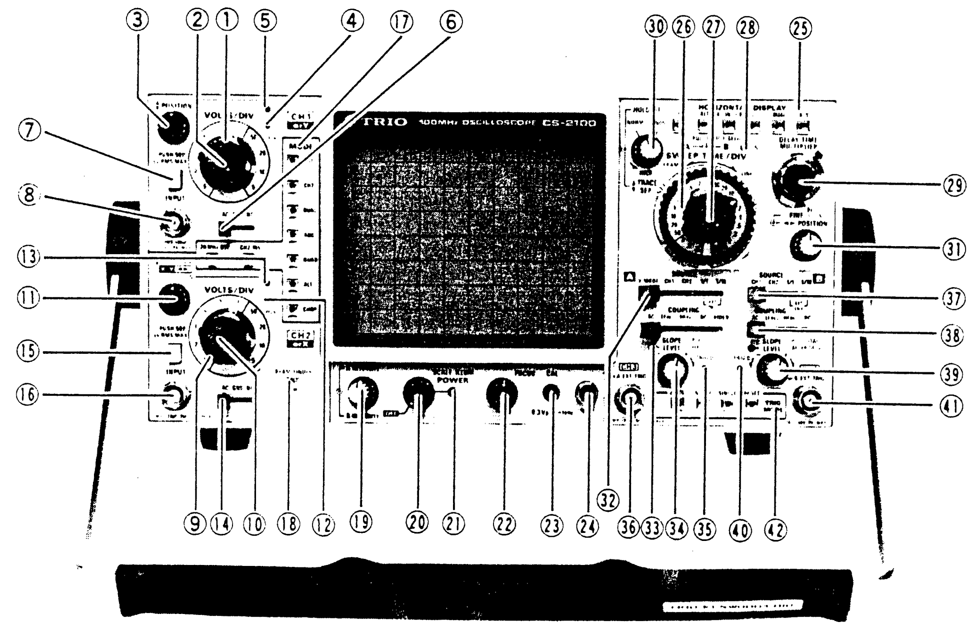
After verifying the setting, connect the AC Power Cord to the line power source.

1) Do not apply input voltage exceeding their maximum rating and never apply external voltage to the input terminals.
   CH1 and CH2:
   1 MΩ: 500Vp-p or 250V (DC + AC peak)
   50Ω: 5Vrms or DC ±5V
   CH3 and CH4: 50V (DC + AC peak)
   Z-axis Input: 50V (DC + AC peak)
2) The following conditions should be avoided:
   (a) Direct sunlight
   (b) High temperatures and humidity
   (c) Mechanical vibration
   (d) Proximity to electrical noise or transient generating machinery.
3) Do not use more than the required beam intensity.
4) Do not leave the beam stationary for long periods.
5) The CS-2100 makes use of internal battery which, if depleted, can cause the panel LED's not to light upon turning the unit ON. If this occurs, refer to the instruction manual for instructions on replacing the battery.
6) To prevent electrical shocks, be sure to connect the GND terminal to an appropriate earth point.
7) Cooling precautions.
   The CS-2100 is provided with a convenient carrying handle which doubles as a stand to adjust the viewing angle. While any arbitrary angle may be set, be sure that no objects are allowed to rest on the top of the unit or that the cooling vents are not blocked, since this will cause an undue temperature rise in the CS-2100.
8) Since the CS-2100 makes use of high voltage circuitry, if removing the case, refer to the "MAINTENANCE" for removing the case.
9) AC voltage selector switch setting.



1 Remove screw and stopper plate.
2 Switch lever to opposite side.
3 Lock lever by attaching stopper plate to opposite side screw.

CONTROLS AND INDICATORS



FRONT PANEL

VERTICAL AXIS CONTROL

(1)VOLTS/DIV

Vertical attenuator for channel 1; provides step adjustment of vertical sensitivity. When the VARIABLE control is turned to the CAL position, the vertical sensitivity is calibrated in 10 steps from 5V/div to 5 mV/div. For X-Y operation this control provides step adjustment of vertical sensitivity.

(2)VARIABLE

Fine adjustment control CH1 vertical attenuation. This control provides continuous adjustment between the VOLTS/DIV ranges. When set to its extreme clockwise (CAL) position, the attenuator is calibrated. For X-Y operation, this control serves as the Y-axis attenuation fine adjustment.

(3)⬍ POSITION/PULL X5 GAIN

This is a potentiometer control with an added switch function. It serves as the CH1 vertical position control for normal operation and X-Y operation as well. When pulled out, the VOLTS/DIV setting is multiplied by 5 and for X-Y operation the Y-axis sensitivity is multiplied accordingly.

In X5 GAIN mode, the vertical gain is increased and the trace becomes thickness.

(4)UNCAL

This LED lights to indicate that CH1 is not calibrated, i.e., that the VARIABLE control is not in the CAL position.

(5)PULL X5 GAIN

This LED lights to indicate that the CH1 ⬍ POSITION control is in the pulled out position, i.e. that the CH1 sensitivity is five times the VOLTS/DIV setting.

(6)AC-GND-DC

This switch is the CH1 vertical axis coupling mode selector, for X-Y operation, the Y-axis coupling mode control.

AC:	AC input coupling, with blocking of any DC signal component.
GND:	Vertical amplifier is disconnected from the input signal and connected to ground. This mode is useful in determining the actual ground potential.
DC:	DC coupling, with both the DC and AC components of the input signal displayed on the CRT.

(7)PUSH 50Ω

This control selects the CH1 input resistance between 50Ω and 1 MΩ. In the depressed position the input resistance is 50Ω.

CAUTIION:

In the 50Ω input mode, the maximum input voltage is 5Vrms or DC ±5V. Care should be taken not to exceed this level as damage to the vertical input circuit could result.

CONTROLS AND INDICATORS

(8)INPUT

CH1 vertical input connector; serves also as the Y-axis input connector for X-Y operation.

(9)VOLTS/DIV

Vertical attenuator for channel 2; provides step adjustment of vertical sensitivity, VARIABLE control is turned to the CAL position, the vertical sensitivity calibrated in 10 steps from 5V/div to 5 mV/div. For X-Y operation the control provides step adjustment of horizontal sensitivity.

(10)VARIABLE

CH2 vertical attenuation fine adjustment. Operation is similar to that of the CH1 VARIABLE control. For X-Y operation the control serves as the X-axis attenuation fine adjustment.

(11)↕ POSITION X-Y ◄►/PULL X5 GAIN

Dual control which functions similarly to the corresponding CH1 control. In addition, it serves as the horizontal position control and X-axis sensitivity magnifier for X-Y operation.

(12)UNCAL

UNCAL display for CH2 vertical axis or for the X-axis for X-Y operation when CH2 VARIABLE control is not in CAL position.

(13)PULL X5 GAIN

This display LED indicates that X5 magnification is in effect for the CH2 vertical axis for normal operation or that it is in effect for the X-axis for X-Y operation.

(14)AC-GND-DC

This switch sets the CH2 vertical axis input coupling mode or the X-axis coupling mode for X-Y operation. Its operation is similar to that of the corresponding control for CH1.

(15)PUSH 50Ω

This switch selects the CH2 input resistance between 50Ω and 1 MΩ. It serves to similarly switch the X-axis input resistance for X-Y operation. Operation is the same as for the corresponding CH1 control.

CAUTION:

The same 5Vrms or DC ±5V limitation applies to the CH2 input when using the 50Ω input resistance mode as discussed above for CH1.

(16)INPUT

CH2 vertical input connector; serves also as the X-axis input connector for X-Y operation.

(17)MODE

Vertical axis mode selection switches.

CH1	Display of CH1 input signal only.
CH2	Display of CH2 input signal only.
DUAL	Display of both CH1 and CH2. For this mode either CHOP or ALT mode will be in effect, selected by the similarly named switches.
ADD	Display of the algebraic sum of CH1 + CH2 or, if CH2 has been inverted, the difference of CH1 − CH2.
QUAD	Display of CH1 through CH4 input signals. For this mode as well as for DUAL, either the ALT or CHOP mode is applicable and selected by the appropriately named switch.
ALT	When DUAL or QUAD mode has been selected, 2 or 4 signal inputs are displayed in an alternating fashion.
CHOP	Similar to ALT but input signals are displayed in a chopped fashion.
CH2 INV	This switch inverts the polarity of the CH2 input signal.
20 MHzBW	This switch when the LED is indicated, limits the vertical bandwidth to approximately 20 MHz.

CAUTION:

The various vertical mode settings are related to horizontal mode and trigger source. See the sections on HORIZONTAL DISPLAY and SOURCE for a description of this relationship.

(18)BEAM FINDER

This push switch is used to shrink the CRT display to allow easy location of the beam.

POWER SUPPLY/CRT DISPLAY CONTROLS

(19)A INTENSITY/B INTENSITY

This dual control allows adjustment of the beam intensity for the A Sweep and B Sweep respectively.

A INTENSITY (center control)
Adjusts the beam intensity for the A Sweep and the display intensity for X-Y operation.

B INTENSITY (outer control)
Adjusts the intensity of the B Sweep beam.

(20)POWER/SCALE ILLUM

This control serves as the power supply switch as well as the adjustment for the scale illumination.

(21)LED PILOT LAMP

This lamp indicates that the power supply has been turned ON.

CONTROLS AND INDICATORS

(22) FOCUS

This focus control can be used to adjust the beam for optimum focus.

Auto-Focus circuit automatically focusing, once this control is adjusted it needs not be frequently readjusted.

(23) CAL

This is the calibration voltage output. 0.3 Vp-p at 1 kHz is available in the form of a square wave signal.

(24) GND

Ground terminal — use it to connect the instrument to the earth ground.

HORIZONTAL AXIS CONTROLS

(25) HORIZONTAL DISPLAY

This control is used to select the horizontal display mode. LED's indicate what mode has been selected.

A	Only A Sweep is operative with the B Sweep dormant.
ALT	A Sweep alternates with the B Sweep. For this mode of operation, the B Sweep waveform appears as an intensified section on the A Sweep.
A-INT-B	Duration of the B Sweep appears as an intensified section on the A Sweep.
B DLY'D	Only Delayed B Sweep is operative.
DUAL	A Sweep and B Sweep operate independently. For this mode the two sweeps are triggered by the A Trigger source and B Trigger source respectively.
X-Y	CH1 becomes the Y-axis and CH2 the X-axis for X-Y operation. The settings of the vertical MODE and TRIG MODE are ineffective.

(26) A SWEEP TIME/DIV, B SWEEP TIME/DIV

A SWEEP TIME/DIV	This outer control is used to set the A Sweep time in 23 ranges in 1-2-5 sequence from 20ns/div to 0.5s/div.
B SWEEP TIME/DIV	This center control sets the B Sweep time in 20 ranges in 1-2-5 sequence from 20ns/div to 50ms/div. This control is constructed to make it impossible to set the B Sweep time slower than the A Sweep time. No fine adjustment is available for the B Sweep time.

(27) A VAR/PULL CHOP F. SELECT

This control is the innermost control on the SWEEP TIME/DIV control. It is the fine adjustment for the A Sweep time. When it is turned fully clockwise to the CAL position, the A Sweep time is calibrated to the setting of the SWEEP TIME/DIV control.

PULL CHOP F. SELECT

The chopping frequency may be changed by pulling this control outward. This is useful in cases where the input signal is synchronized to the chopping frequency.

(28) UNCAL

This LED lights to indicate that the A VAR control is not set to the CAL position and thus that the A Sweep time is not calibrated.

(29) DELAY TIME MULTIPLIER

This control adjusts the start time of the B Sweep to some delay time after the start of the Sweep.

The delay time may be set to values between 0.2 and 10 times the setting of the A SWEEP TIME/DIV control.

(30) ⇕ TRACE SEP/HOLDOFF

⇕ TRACE SEP

This outer control allows the adjustment of the B Sweep up to 4 divisions below the A Sweep. turning this control to counterclockwise. This control has effect in the B DLY'D mode of HORIZONTAL DISPLAY as well as the DUAL mode of operation.

HOLDOFF

A dual control incorporating a switching function.

As a holdoff adjustment, it allows the adjustment of the time between successive sweeps. Turning the control counterclockwise from the NORM position lengthens the holdoff time until just before the B ENDS A when the holdoff time is more than 10 times the NORM value.

In the B ENDS A position (fully counterclockwise), the A Sweep is reset at the end of the B Sweep.

B ENDS A mode is applicable to the ALT, A-INT-B and B DLY'D modes of HORIZONTAL DISPLAY.

(31) ◄► POSITION/FINE PULL X10 MAG

A combination adjustment/switch control.

This control is not used for X-Y operation.

◄► POSITION

Horizontal position coarse adjustment.

FINE PULL X10 MAG

Horizontal position fine adjustment. When this control is pulled out, the sweep time is made 10 times shorter.

CONTROLS AND INDICATORS

TRIGGER SOURCE CONTROLS

(32)SOURCE

This control selects the source for the A Sweep Trigger.

V MODE The trigger source for the A Sweep is determined by the Vertical MODE setting.

CH1	CH1 signal is used as a trigger source
CH2	CH2 signal is used as a trigger source
ADD	The algebraic sum of CH1 and CH2 signals isured a signal source. (if CH2 has been inverted, the difference becomes the source.)
DUAL QUAD (ALT) (CHOP)	For ALT mode the signals for CH1 through CH4 alternate as the trigger source. For the CHOP mode the chopping signal becomes the trigger source.

CAUTION:

1. When the vertical MODE is selected in CHOP, the display cannot be synchronized with the input signal since the chopping signal becomes the trigger source.
2. Triggering is impossible when input signals are not applied to all channels with the vertical axis mode set to DUAL or QUAD.

CH1	CH1 signal is the trigger source for the A Sweep.
CH2	CH2 signal is the trigger source for the A Sweep.
1/1	CH3 signal is the trigger source for the A Sweep.
1/10	The CH3 signal, attenuated to 1/10 of its true value is the trigger source for the A Sweep.

(33)COUPLING

This control is used to select the SYNC coupling for the A trigger.

AC	SYNC signal is AC coupled with any DC component blocked.
$\mathrm{LF_{REJ}}$	SYNC signal is coupled through a high-pass filter to eliminate low frequency components for stable triggering of high frequency signals.
$\mathrm{HF_{REJ}}$	SYNC signal is coupled through a low-pass filter to eliminate high frequency components for a stable triggering of low frequency signals.
DC	The SYNC signal is DC coupled for SYNC which includes the effects of DC components. For CH3 and CH4, the vertical position adjustment has no effect on the trigger point.
VIDEO	For synchronization of video signals. The position of the A SWEEP TIME/DIV control determines whether FRAME or LINE is to be synced. Settings between 0.5s and 0.1ms result in FRAME while those between 50 μs and 20 ns result in LINE sync.

(34)LEVEL/SLOPE PULL FIX

LEVEL

This outer control adjusts the level at which the A trigger causes the A Sweep be started.

SLOPE PULL FIX

This inner control adjusts the slope of the A trigger signal. When the control is pulled out the FIX mode is selected for auto level adjustment, under which circumstances outer TRIG LEVEL control no longer has any effect.

(35)TRIG'D

This green LED lights when the A trigger source signal causes the initiation of a A Sweep. It lights for X-Y operation as well.

(36)CH3 or A EXT TRIG

Input connector for the CH3 signal. It serves also as the external A TRIG input connector. CH3 signal may be observed simultaneously with CH1, 2 and 4 signals when the QUAD mode is selected.
When the SOURCE control is set to either EXT (CH3) 1/1 or 1/10, the trigger source is this input signal.

(37)SOURCE

This control selects the B Sweep trigger source.

CH1	CH1 signal is the trigger source for the B Sweep.
CH2	CH2 signal is the trigger source for the B Sweep.
1/1	CH4 signal is the trigger source for the B Sweep.
1/10	The CH4 signal, attenuated to 1/10 of its true value is the trigger source for the B Sweep.

(38)COUPLING

This control selects the SYNC coupling for the B trigger group. Operation is similar to that of the corresponding A Sweep trigger coupling select control except that VIDEO is not available.

(39)LEVEL/SLOPE PULL STARTS AFTER DELAY

LEVEL

This outer control adjusts the level at which the B trigger signal causes the start of the B Sweep.

SLOPE PULL STARTS AFTER DELAY

This control selects the slope of the B trigger signal. For B trigger operation it must be set in its pushed in position. When it is pulled out, the B Sweep starts immediately after the delay time selected by the DELAY TIME MULTIPLIER and A SWEEP TIME/DIV control, regardless of the TRIG LEVEL setting.

CONTROLS AND INDICATORS

(40)TRIG'D

This green LED lights when the B trigger source signal causes the B triggered sweep to be initiated.

(41)CH4 or B EXT TRIG

Input connector for the CH4 signal; serves also as the B TRIG external input connector. CH4 signal may be observed simultaneously with CH1, 2 and 3 signals when the QUAD mode is selected. When the SOURCE select control is set to either EXT (CH4) 1/1, or 1/10, the trigger source is this input signal.

(42)TRIG MODE

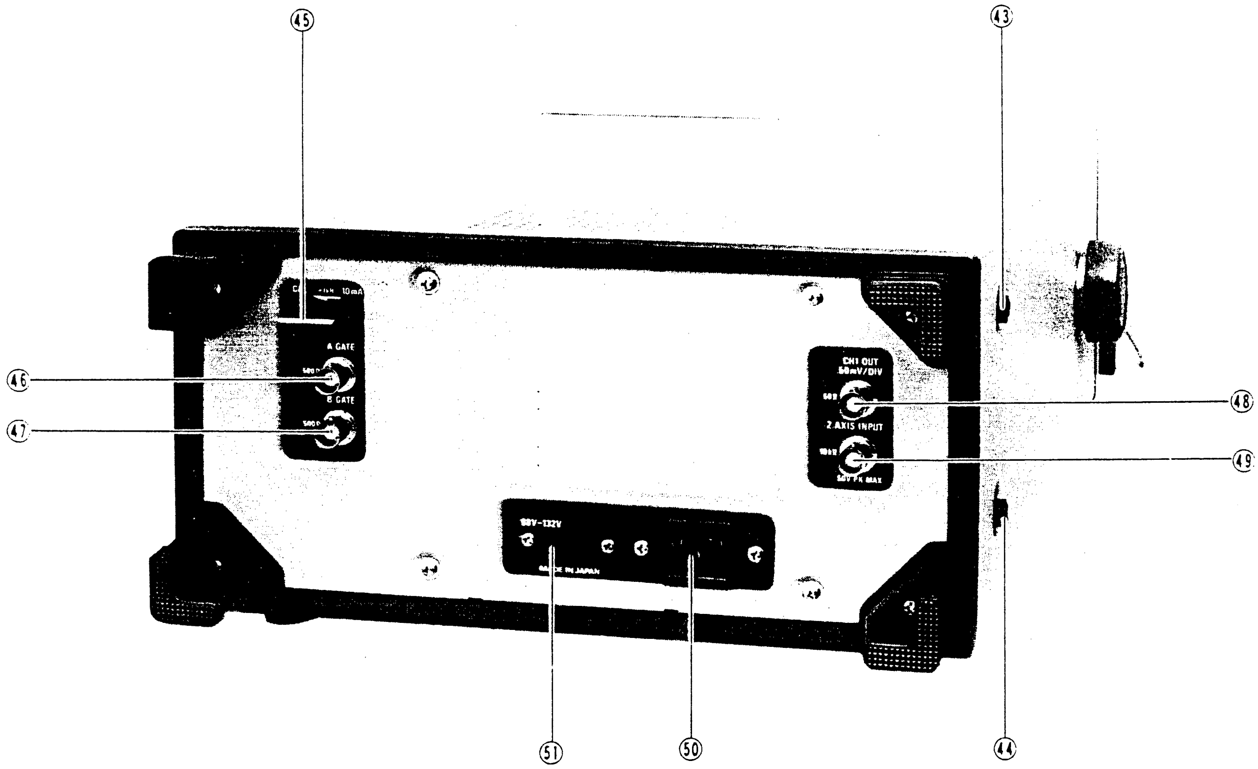
This control selects the Trigger Mode. A corresponding LED lights to indicate which mode has been selected.

AUTO	Sweep is initiated in triggered operation but the trace is swept even in the absence of a trigger signal.
NORM	Triggered operation but no trace is presented when a proper trigger signal is not applied.
SINGLE	Single sweep operation. Note that in this mode, simultaneous observation of both the A and B Sweeps is not possible.
RESET	This is the reset button for single sweep operation. Its LED remains lighted until the main A Sweep ends.

CAUTION:

For dual or quad trace, single sweep operation MODE must not be set to ALT. Use the CHOP mode instead.

SIDE PANEL AND REAR PANEL CONTROLS



(43)CH3 POSITION

This adjustment controls the vertical position of the CH3 signal on the CRT display.

(44)CH4 POSITION

Similar to the CH3 POSITION control but for CH4.

(45)CAL

Current Probe calibration loop. A 10 mA 1 kHz (approx.) square wave is provided.

(46)A GATE

The output connector for the A Sweep gate, a square wave gate signal.

(47)B GATE

Same as A GATE but for the B Sweep gate.

(48)CH1 OUT

The CH1 vertical output signal connector.

For cascaded operation this output is connected to the CH2 input.

CONTROLS AND INDICATORS

(49)Z. AXIS INPUT

External intensity modulation input connector. TTL level input; intensity increases for increasing positive inputs.

(50)POWER LINE CONNECTOR

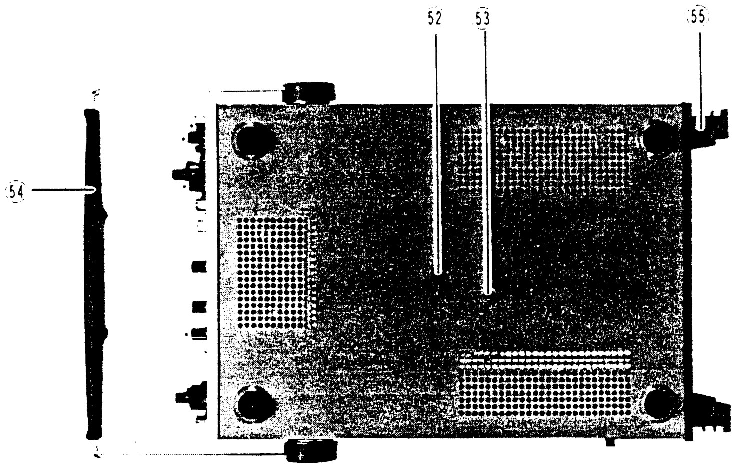
The input connector for the AC power cord.

(51)LINE VOLTAGE SWITCH

This switch is used to select the power supply input voltage.

LOW	90 ~ 132VAC
HIGH	180 ~ 264VAC

BOTTOM PANEL



(52)TRACE ROTATION

This control is used to compensate for trace rotation distortion.

Once this control is adjusted it needs not be frequently readjusted.

(53)ASTIG

This control is used to compensate for trace or spot astigmatism.

Once this control is adjusted it needs not be frequently readjusted.

(54)Handle

The handle of the CS-2100 can be set to desired angle so that the CS-2100 is inclined for easy operation. The handle turns in 15 degree steps.

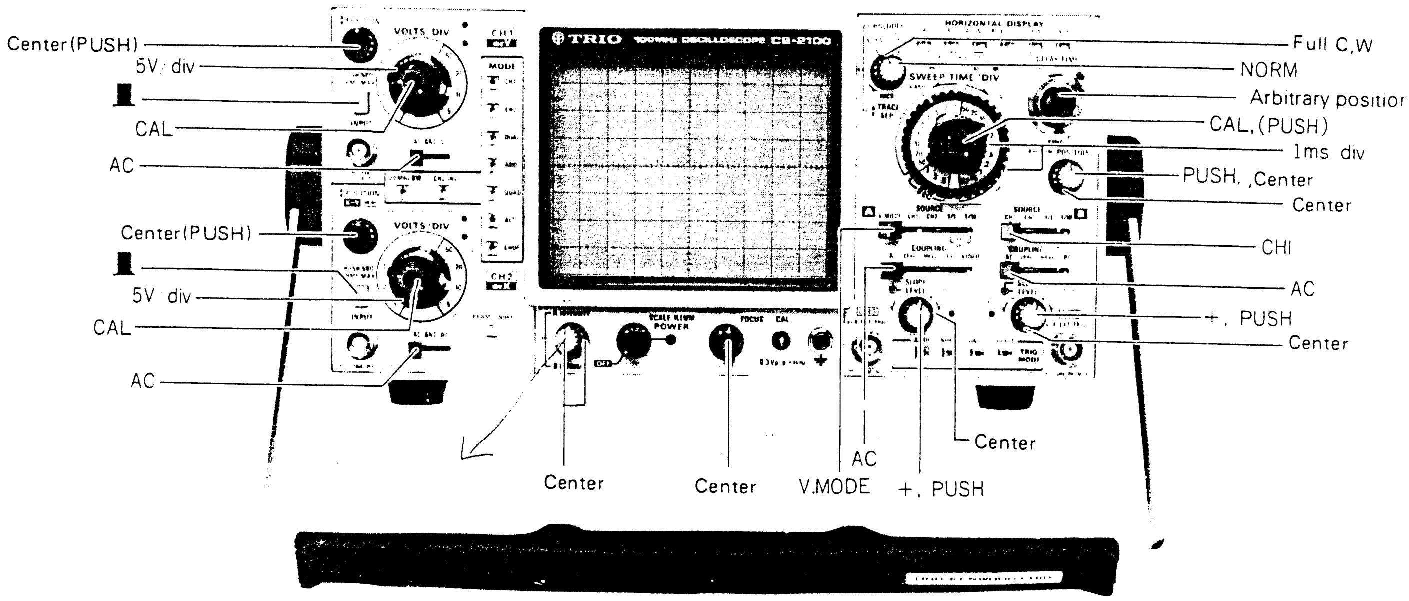
The supplied probe holder can be installed in the metal portion of the holder.

(55)Feet

Feet support oscilloscope in vertical position (face up) and serve as cord wrap for storing power cord.

OPERATION

Before turning the CS-2100 on, set the front panel controls as follows, referring to the section on FRONT PANEL in this manual.



[1] NORMAL SWEEP DISPLAY OPERATION

1. Turn the POWER control (20) clockwise — the power supply will be turned on and the pilot lamp will light with the other LED's for the previously set MODE (17), HORIZONTAL DISPLAY (25) and TRIG MODE (42) also lighting.

   Set these modes as follows:
   MODE (17) : CH1
   HORIZONTAL MODE (25) : A
   TRIG MODE (42) : AUTO

2. The trace will appear in the center of the CRT display and can be adjusted by the CH1 ⬍ POSITION (3) and ◂▸ POSITION (31) controls. Next, adjust the A INTENSITY (19) and, if necessary, the FOCUS (22) for ease of observation.
3. Apply an input signal to CH1 INPUT (8) and adjust VOLTS/DIV (1) for a suitable size display of the waveform. If the waveform does not appear in the display, use the BEAM FINDER (18) to locate the waveform adjust the VOLTS/DIV and ⬍ POSITION to bring the waveform confortably into the center of the CRT display.

   Operation with a signal applied to the CH2 INPUT (16) and the MODE set to CH2 is similar to the above procedure. In the ADD mode the algebraic sum of CH1 + CH2 is displayed. If the CH2 INV switch has been pressed, the algebraic difference of the two waveforms, CH1 − CH2 is displayed. If both channels are set to the same VOLTS/DIV, the difference waveform can be read directly in VOLTS/DIV off of the CRT. DUAL mode allows simultaneous observation of CH1 and CH2 while QUAD provides viewing of CH1 through CH4 simultaneously.

   In the DUAL or QUAD mode one of either CHOP or ALT modes applies and should be selected. In the ALT mode, CH1 and CH2 or CH1 through CH4 are displayed in an alternating fashion.

   Note that in the CHOP mode of operation with the SOURCE (32) set to V.MODE, the trigger source is the chopping signal itself, making waveform observation impossible. Use ALT mode instead in such cases. SOURCE must be set to one of CH1, CH2 or CH3.

4) To adjust the trigger point to capture elusive waveforms, use the A trigger Control Group.

TRIGGERING Operation

The input signal must be properly triggered for stable waveform observation. Triggering is possible the input signal internally to create a trigger or with an externally provided signal of fixed timing relationship to the observed signal, applying such a signal to the EXT TRIG input connector.

OPERATION

A Trigger

1) The SOURCE control selects the signal to be used. With the V. MODE the source is determined by the setting of the Vertical MODE.
As mentionned above, if CHOP has been selected, the trigger source is the chopping signal itself, making waveform observation impossible. Use ALT instead in this case. If SOURCE is set to CH1 or CH2, regardless of the setting of MODE, CH1 or CH2 signal provides the trigger source.
If SOURCE is set to EXT (CH3) 1/1, or 1/10, except for QUAD operation, the signal applied to the CH3 or A EXT TRIG input (36) is the trigger source. For QUAD operation this input is taken as the CH3 signal and can be observed as the trigger waveform.

2) After setting SOURCE, adjust the LEVEL/SLOPE (34) control to set the trigger point. Sync is indicated by the green LED lighting.
As necessary to obtain a stable synchronized signal display, adjust HOLDOFF (30) and COUPLING (33).
If the SLOPE control is pulled out, the trigger level is put into the FIX mode with the trigger point at the center of the waveform.

5. Adjust the A SWEEP TIME/DIV (26) control for an appropriate display of the signal input. If required, use the A VAR (27) control as well.
This completes the adjustment procedure for normal A Sweep display operation.

[2] MAGNIFIED SWEEP OPERATION

Since merely shortening the sweep time to magnify a portion of an observed waveform can result in the desired portion disappearing off the screen, such magnified display should be performed using the MAGNIFIED SWEEP.

Procedure:

Using the ◄► POSITION control, adjust the desired portion of waveform to the center of the CRT. Pull out the FINE PULL X10 MAG (31) control to magnify the display 10 times. For this type of display the sweep time is the SWEEP TIME/DIV setting divided by 10.

[3] DELAYED SWEEP OPERATION

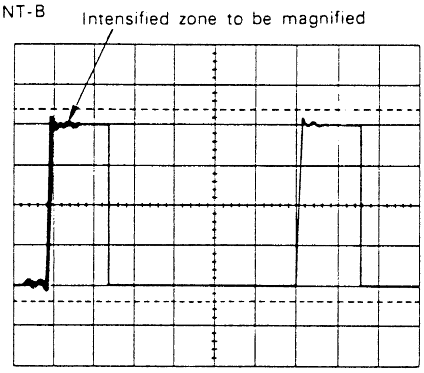
Delayed sweep operation is achieved by use of both the A Sweep and the B Sweep.

Procedure:

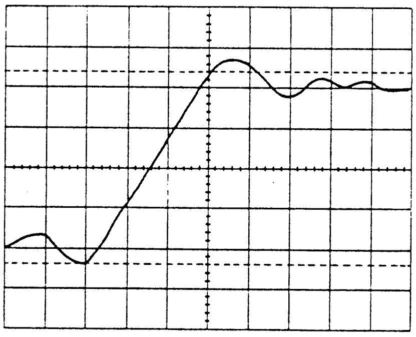
1. First set the HORIZONTAL DISPLAY to A and adjust the CS-2100 for a normal waveform display.
2. Pull out the SLOPE PULL STARTS AFTER DELAY (39) control to set the sweep in the STARTS AFTER DELAY mode.
Set the HORIZONTAL DISPLAY to the A-INT-B mode and a portion of the B Sweep representing the B SWEEP TIME/DIV will appear as an intensified portion of the A Sweep.
The B Sweep intensity is adjusted using the B INTENSITY control (19).
3. Shift the intensified portion of waveform (section to be magnified) along the A Sweep by use of the DELAY TIME MULTIPLIER (29).
4. Set the HORIZONTAL DISPLAY to B DLY'D to display the A-INT-B intensified portion as a magnified B DLY'D sweep.

   Delay Time (magnified portion) = DELAY TIME MALTIPLIER setting × A SWEEP TIME/DIV setting.
5. For STARTS AFTER DELAY operation, apparent jitter increases as magnification increases. To obtain a jitter free display, push in the SLOPE PULL STARTS AFTER DELAY control. In this mode the signal selected by the B SOURCE switch (37) becomes the B trigger source, making use of the B LEVEL (39) control to set the trigger point.
B SOURCE, COUPLING and LEVEL SLOPE are set in a manner similar to that of the corresponding controls for A Sweep.

A-INT-B



B DLY'D



OPERATION

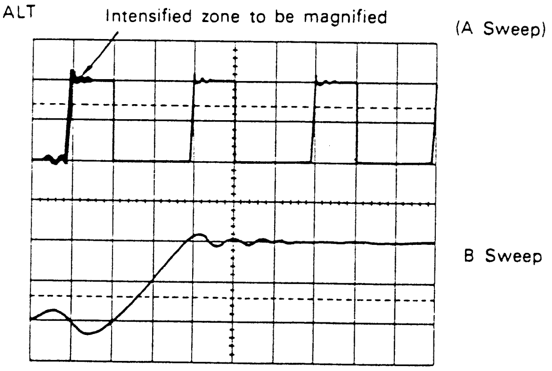
Note that for this type of operation both the DELAY TIME MULTIPLIER and TRIG LEVEL affect the start of the sweep so that the delay time is used as a reference point.

[4] ALTERNATING SWEEP OPERATION

A Sweep and B Sweep are usable in an alternating fashion making it possible to observe both the normal and magnified waveform simultaneously.

Procedure:

1. Set the HORIZONTAL DISPLAY to A and adjust the CS-2100 for a normal waveform display.
2. Pull out the SLOPE PULL STARTS AFTER DELAY control and set the HORIZONTAL DISPLAY to ALT. Adjust TRACE SEP (30) for easy observation of both the A and B traces.
   The upper trace is the non-magnified portion of the waveform with the magnified portion super-imposed as an intensified section. The lower waveform is the intensified portion displayed magnified.
   B INTENSITY can be used to adjust the intensity of the super-imposed waveform.
3. The DELAY TIME MULTIPLIER can be used to continuously slide the magnified portion of the waveform across the A Sweep period to allow magnification of precisely the desired portion of waveform.
4. Apparent display jitter increases with increased magnification as is the case with delayed sweep discussed above. By cancelling the magnified operating mode by pushing in the SLOPE PULL STARTS AFTER DELAY control the B LEVEL control can be used to set the trigger point.



[5] DUAL SWEEP OPERATION

Up until now we have discussed using the B Sweep to display only a Delayed Sweep of the A Sweep signal. In the DUAL mode A and B Sweep are performed independently so that two non time-related signals can be observed at one time.

Procedure:

The A Sweep and B Sweep are controlled by the A trigger and B trigger controls respectively.

While triggering of A and B Sweeps independently using the input signals themselves is quite simple and presents no particular problems, use of a common trigger source or use of A to trigger B and vice versa can result in some impossible triggering conditions for signals that are not related to each other in a timing sense.

For DUAL operation the A and B Sweeps alternate regardless of the setting of the ALT and CHOP switches.

This A Sweep/B Sweep/Trigger Source/Vertical MODE relationships are outlined in the following tables.

A SOURCE (A Sweep)

		MODE					
		CH1	CH2	DUAL	ADD	QUAD	
SOURCE	V. MODE	CH1	CH2	CH1, CH2 ALT (*1)	CH1 + CH2	CH1 ~ CH4 ALT (*2)	Trigger Source
		CH1	CH2	CH1	CH1 + CH2	CH1, CH3	CRT Display
	CH1	CH1	CH1	CH1	CH1	CH1	Trigger Source
		CH1	CH2	CH1	CH1 + CH2	CH1 CH3 ALT (*3)	CRT Display
	CH2	CH2	CH2	CH2(*7)	CH2	CH2(*7)	Trigger Source
		CH1	CH2	CH1	CH1 + CH2	CH1, CH3 ALT	CRT Display
	EXT CH3	CH3	CH3	CH3	CH3	CH3	Trigger Source
		CH1	CH2	CH1	CH1 + CH2	CH1, CH3 ALT (*4)	CRT Display

B SOURCE (B Sweep)

		MODE					
		CH1	CH2	DUAL	ADD	QUAD	
SOURCE	CH1	CH1	CH1	CH1(*7)	CH1	CH1(*7)	Trigger Source
		CH1	CH2	CH2	CH1 + CH2	CH2, CH4	CRT Display
	CH2	CH2	CH2	CH2	CH2	CH2	Trigger Source
		CH1	CH2	CH2	CH1 + CH2	CH2, CH4 (*5)	CRT Display
	EXT CH4	CH4	CH4	CH4	CH4	CH4	Trigger Source
		CH1	CH2	CH2	CH1 + CH2	CH2, CH4 (*6)	CRT Display

*Note 1: A Sweep is triggered by alternate signals from CH1 and CH2, but only the CH1 signal on the display is triggered.

*Note 2: A Sweep is triggered by alternate signals from CH1 ∿ CH4, but only the CH1 and CH3 signals on the display are triggered.

*Note 3: A Sweep is triggered by CH1 signal and CH1 and CH3 signals are displayed.

*Note 4: A Sweep is triggered by CH3 signal and CH1 and CH3 signals are displayed.

*Note 5: B Sweep is triggered by CH2 signal and CH2 and CH4 signals are displayed.

*Note 6: B Sweep is triggered by CH4 signal but CH2 and CH4 signals are displayed.

*Note 7: If there is no time relation between CH1 and CH2 input, triggereing is not possible.

Please bear in mind these relationship when using DUAL mode operation with the CS-2100.

OPERATION

CAUTION:
For DUAL operation be sure to set the TRIG MODE control to AUTO to allow sweep of both A and B to be performed. When A and B Sweeps are to be used alternately, the CS-2100 must be set up to provide both sweeps. For Dual Mode when the difference in sweep times between A and B is small, a portion of the B trace may disappear.

[6] X-Y OPERATION

Phase difference measurements may be made with the CS-2100 by use of the X-Y display mode.

Procedure:
Set the HORIZONTAL DISPLAY control to the X-Y mode. In this mode the CH1 input becomes the Y-axis input and the CH2 input the X-axis input for X-Y display.
For X-Y operation the X and Y positions are adjusted using the CH2 ▲▼ POSITION X-Y ◀▶ and CH1 ▲▼ POSITION controls respectively.

X and Y sensitivity is set by using the CH2 and CH1 VARIABLE, VOLTS/DIV controls respectively.
By pulling out the two above mentioned POSITION controls, the sensitivity of both the X and Y axis is magnified by 5 times.
The A INTENSITY control is used to adjust the intensity of the display during X-Y operation.

[7] SINGLE SWEEP OPERATION

This mode of display is useful for looking at non-synchronous or one time events.

Procedure:

1. Set the TRIG MODE to either AUTO or NORM, and the SLOPE PULL FIX to pushed in positon.
   Apply a signal of approximately the same amplitude and frequency as the signal that is to be observed to the CS-2100 as the trigger signal and set the trigger level.
2. Set TRIG MODE to SINGLE and press the RESET button — observe that the green LED lights to indicate the reset condition. This LED goes out when the A Sweep period is completed.
3. After the above set-up is completed the CS-2100 is ready to operate in the SINGLE sweep mode of operation after resetting the instrument using the RESET button. Input of the trigger signal results in one and only one sweep.

CAUTION:
With the HORIZONTAL DISPLAY set to ALT or DUAL, the simultaneous observation of the A Sweep and B Sweep waveforms at SINGLE SWEEP mode is not possible. Also for DUAL or QUAD operation simultaneous observation is not possible using ALT mode. Set the unit to the CHOP mode in this case,

[8] DUAL AND QUAD TRACE OPERATION

By setting the MODE to DUAL or QUAD, Dual and Quad trace operation can be achieved. When necessary, setting HORIZONTAL DISPLAY to ALT can in addition turn the CS-2100 into an 8-trace instrument.
Operation of the various controls is for this type of display mode similar to the operaton described above.

[9] CASCADED OPERATION

This mode of operation is used when sensitivity greater than 1 mV/div is required.
Procedure:

1. Connect the CH1 output to the CH2 input using a BNC cable.
2. For cascade operation depress the CH1 and CH2 × 5 GAIN switches.
3. Push the CH2 50Ω switch and set V MODE to CH2.
4. Set the CH1 and CH2 VOLTS/DIV to 5 mV and input a signal for a sensitivity of 500 μV/div on CH1.

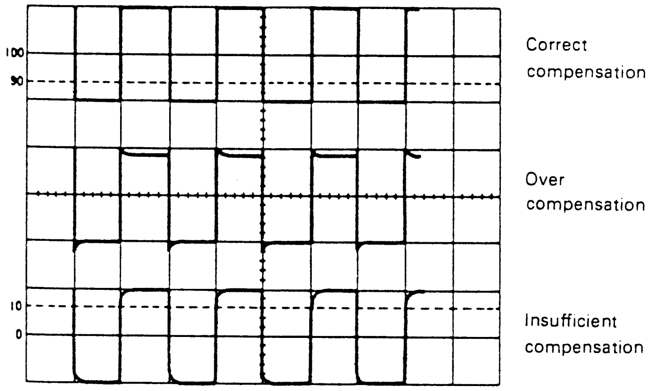
APPLICATION

ADJUSTMENTS REQUIRED BEFORE STARTING MEASUREMENTS

PROBE COMPENSATION

If accurate measurements are to be made, the effect of the probe being used must be properly adjusted output of the measurement system using the internal calibration signal or some other squarewave source.

1. Connect the probe to the channel to be used and set the various controls for a normal A sweep display.
2. Adjust the SWEEP TIME/DIV control display of several cycles of the signal from the calibration output, CAL, terminal.
3. Adjust the probe compensation control for a proper waveform display.
4. The other channels are compensated for in the same way. Note that for CH3 and CH4 the sensitivity is 0.1V/DIV (1/1) so that when using a 10:1 probe sufficient waveform amplitude is not available, so that an alternate squarewave signal generator must be used for the compensating procedure.



TRACE ROTATION COMPENSATION

Rotation from a horizontal trace position can be the cause of measurement errors.
Adjust the CS-2100 controls for a normal display. Set the AC-GND-DC switch to GND and TRIG MODE to AUTO. Adjust the ↕ POSITION control such that the trace is over the center horizontal graduation line.
If the trace appears to be rotated from horizontal, align it with the center graduation line using the TRACE ROTATION control located on the bottom of the instrument.

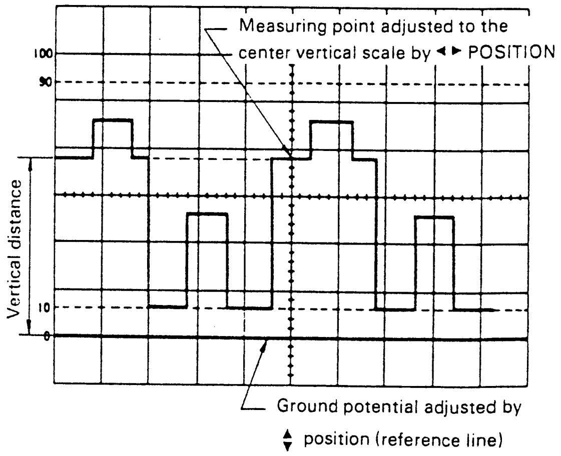
MEASUREMENTS

DC VOLTAGE MEASUREMENTS

This procedure describes the measurement procedure for DC waveforms.
Procedure:

1. Connect the signal to be measured to the INPUT connector and set the V MODE to the channel to be used. Set the VOLTS/DIV and SWEEP TIME/DIV switch to obtain a normal display of the waveform to be measured. Set the VARIABLE control to the CAL position.
2. Set TRIG MODE to AUTO and AC-GND-DC to the GND position to determine the true ground level. Using the ↕ POSITION control adjust the trace position to the reference level position, making sure not to disturb this setting once made.
3. Set the AC-GND-DC switch to the DC position to observe the input waveform, including its DC component. If an appropriate reference level or VOLTS/DIV setting was not made, the waveform may not be visible on the CRT screen at this point. If so, press BEAM FINDER to locate it and reset VOLTS/DIV and/or the ↕ POSITION control.
4. Use the ◄► POSITION control to bring the portion of the waveform to be measured to the center vertical graduation line of the CRT screen.
5. Measure the vertical distance from the reference level to the point to be measured, (the reference level can be checked by setting the AC-GND-DC switch again to GND).
   Multiply the distance measured above by the VOLTS/DIV setting and is the probe used is not a 1:1 probe, by the probe attenuation ratio as well. If "× 5 GAIN" has been set multiply the value by 1/5 as well. Voltages above and below the reference level are positive and negative values respectively.

Using the formula:
DC level = Vertical distance in divisions × (VOLTS/DIV setting) × (probe attenuation ratio) × "× 5 GAIN" value^{-1} (1/5)


Measuring point adjusted to the center vertical scale by ◄► POSITION
100
90
10
0
Vertical distance
Ground potential adjusted by ↕ position (reference line)

[EXAMPLE]
For the example, the point being measured is 3.8 divisions from the reference level (ground potential).
If the VOLTS/DIV was set to 0.2V and a 10:1 probe was used.
Substituting the given values-
DC level = 3.8 (div) × 0.2(V) × 10 = 7.6V

APPLICATION

MEASUREMENT OF THE VOLTAGE BETWEEN TWO POINTS ON A WAVEFORM

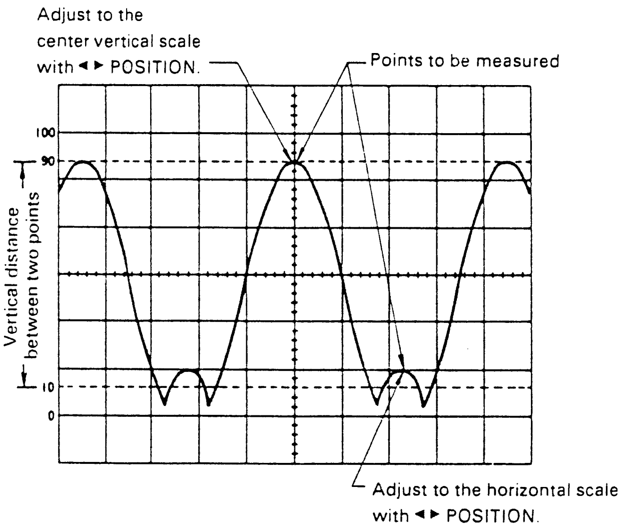
This technique can be used to measure peak-to-peak voltages.

Procedure:

1. Apply the signal to be measured to the INPUT, set the V MODE to the channel to be used and AC-GND-DC to AC, adjusting VOLTS/DIV and SWEEP TIME/DIV for a normal display. Set VARIABLE to the CAL position.
2. Using the ⬍ POSITION control adjust the waveform position such that one of the two points falls on a CRT graduation line and that the other is visible on the display screen.
3. Using the ◀▶ POSITION control, adjust the second point to coincide with the center vertical graduation line.
4. Measure the vertical distance between the two points and multiply this by the setting of the VOLTS/DIV control.
   If a probe is used, further multiply this by the attenuation ratio, if any and if " × 5 GAIN" is used, multiply the value by 1/5 as well.

Using the formula:

Volts Peak-to-Peak
= Vertical distance (div) × (VOLTS/DIV setting)
× (probe attenuation ratio) × " × 5 GAIN" value^{-1}
(1/5)


Adjust to the center vertical scale with ◀▶ POSITION.
Points to be measured
100
90
10
0
Vertical distance between two points
Adjust to the horizontal scale with ◀▶ POSITION.

[EXAMPLE]

For the example, the two points are separated by 4.4 divisions vertically. Let the VOLTS/DIV setting be 0.2V/div and the probe attenuation be 10:1.

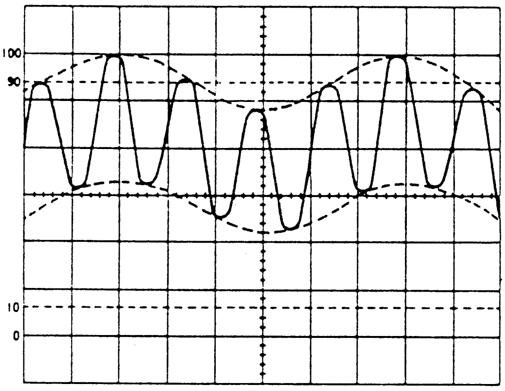
Substituting the given value:
Voltage between two points = 4.4 (div) × 0.2 (V) × 10 = 8.8V

ELIMINATION OF UNDESIRED SIGNAL COMPONENTS

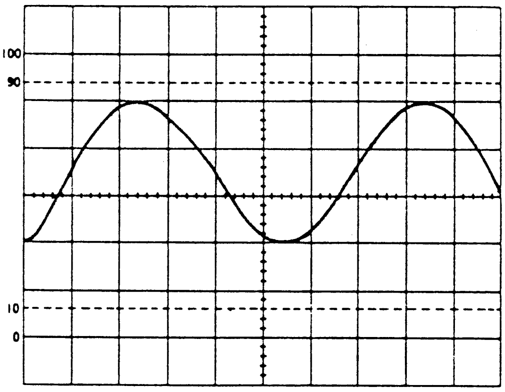
The ADD feature can be conveniently used to cancel out the effect of an undesired signal component which is riding on the back of the signal you wish to observe.

Procedure:

1. Apply the signal containing an undesired component to the CH1 INPUT and the undesired signal itself alone to the CH2 INPUT.
2. Set the V MODE to DUAL (CHOP) and SOURCE to CH2. Verify that CH2 represents the unwanted signal in reverse polarity. If necessary reverse polarity by setting CH2 to INV.
3. Set V MODE to ADD, SOURCE to V MODE and CH2 VOLTS/DIV and VARIABLE so that the undesired signal component is cancelled as much as possible. The remaining signal should be the signal you wish to observe alone and free of the unwanted signal.

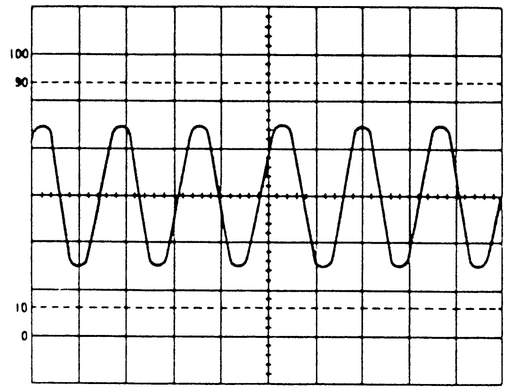


Signal containing undesired component
(Broken lines: undesired component envelope)



Undesired component signal

APPLICATION



Signal without undesired component

TIME MEASUREMENTS

This is the procedure for making time measurements between two points on a waveform. The combination of the SWEEP TIME/DIV and the horizontal distance in divisions between the two points is used in the calculation.

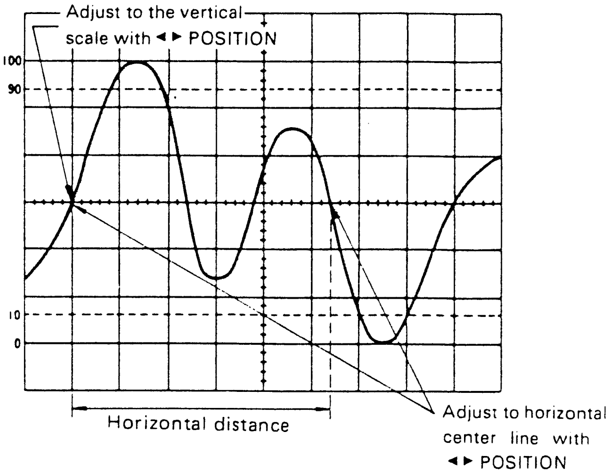
Procedure:

1. Apply the signal to be measured to the INPUT connector and set the V MODE to the channel to be used. Adjust VOLTS/DIV and SWEEP TIME/DIV for a normal display.
   Be sure that the VARIABLE control is set to CAL.
2. Using the ⬍ POSITION control set one of the points to be used as a reference to coincide with the horizontal centerline.
   Use the ◀▶ POSITION control to set this point at the intersection of any vertical graduation line.
3. Measure the horizontal distance between the two points.
   Multiply this by the setting of the A SWEEP TIME/DIV control to obtain the time between the two points. If horizontal " × 10 MAG" is used, multiply this further by 1/10.

Using the formula:
Time = Horizontal distance (div) × (SWEEP TIME/DIV setting) × " × 10 MAG" value^{-1} (1/10)

[EXAMPLE]

For the example, the horizontal distance between the two points is 5.4 divisions.
If the SWEEP TIME/DIV is 0.2ms/div we calculate.


Adjust to the vertical scale with ◀▶ POSITION
100
90
10
0
Horizontal distance
Adjust to horizontal center line with ◀▶ POSITION

Substituting the given value:
Time = 5.4 (div) × 0.2 (ms) = 1.08ms

FREQUENCY MEASUREMENTS

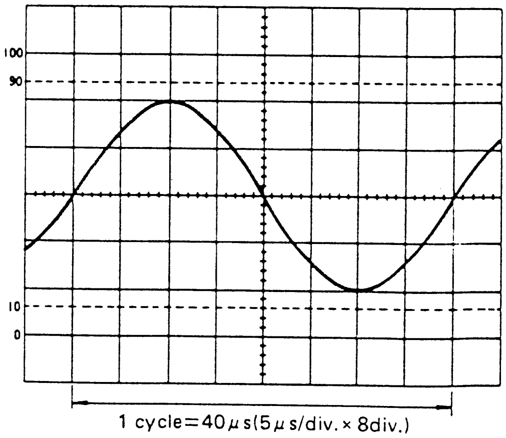
Frequency measurements are made by measuring the period of one cycle of waveform and taking the reciprocal of this time value as the frequency.

Procedure:

1. Set the oscilloscope up to display one cycle of waveform (one period).
2. The frequency is the reciprocal of the period measured.

Using the formula:

$$\text{Freq} = \frac{1}{\text{period}}$$



1 cycle=40µs(5µs/div. × 8div.)

[EXAMPLE]

A period of 40µs is observed and measured.

Substituting the given value:
Freq = $1/[40 \times 10^{-6}] = 2.5 \times 10^{4} =$ 25 kHz

APPLICATION

While the above method relies on the measurement directly of the period of one cycle, the frequency may also be measured by counting the number of cycles present in a given time period.

1. Apply the signal to the INPUT, setting the V MODE to the channel to be used and adjusting the various controls for a normal display. Set A VAR to CAL.
2. Count the number of cycles of waveform between a chosen set of vertical graduation lines.
   Using the horizontal distance between the vertical lines used above and the SWEEP TIME/DIV the time span may be calculated. Multiply the reciprocal of this value by the number of cycles present in the given time span.
   If " × 10 MAG" is used multiply this further by 10.
   Note that errors will occur for displays having only a few cycles.

Using the formula:

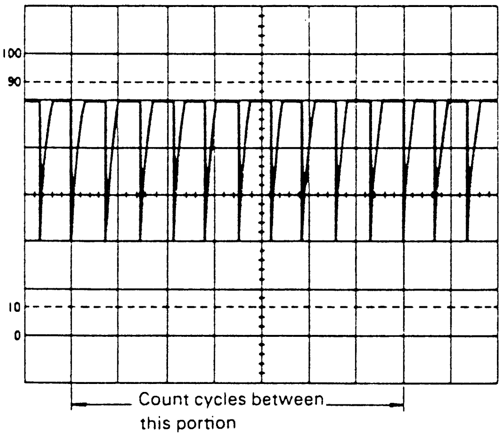
$$\text{Freq} = \frac{\#\ \text{of cycles} \times \text{" × 10 MAG" value}}{\text{Horizontal distance (div)} \times \text{SWEEP TIME/DIV setting}}$$

[EXAMPLE]

For the example, within 7 divisions there are 10 cycles.
The SWEEP TIME/DIV is 5μs.

Substituting the given value:

$$\text{Freq} = \frac{10}{7 \times 5\ (\mu s)} \doteqdot 285.7\ \text{kHz}$$



PULSE WIDTH MEASUREMENTS

Procedure:

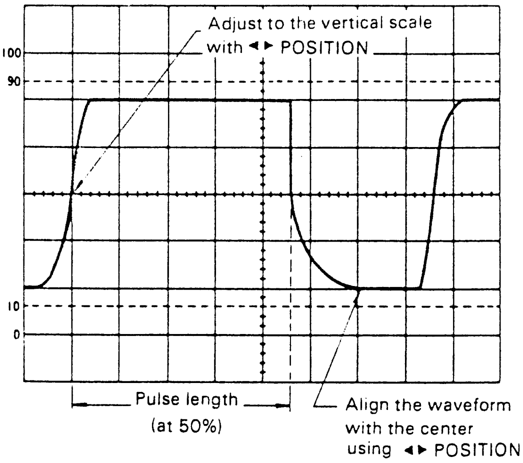
1. Apply the pulse signal to the INPUT and set the V MODE to the channel to be used.
2. Use VOLTS/DIV, VARIABLE and ⇕ POSITION to adjust the waveform such that the pulse is easily observed and such that the center pulse width coincides with the center horizontal line on the CRT screen.
3. Measure the distance between the intersection of the pulse waveform and the center horizontal line in divisions. Be sure that the A VAR is in the CAL position. Multiply this distance by the A SWEEP TIME/DIV and by 1/10 is " × 10 MAG" mode is being used.

Using the formula:
Pulse width = Horizontal distance (div) × (SWEEP TIME/DIV setting) × " × MAG 10" value^{-1} (1/10)

[EXAMPLE]

For the example, the distance (width) at the center horizontal line is 4.6 divisions and the A SWEEP. TIME/DIV is 0.2ms.

Substituting the given value:
Pulse width = 4.6 (div) × 0.2ms = 0.92ms


Adjust to the vertical scale with ◀▶ POSITION
100
90
10
0
Pulse length (at 50%)
Align the waveform with the center using ◀▶ POSITION

PULSE RISETIME AND FALLTIME MEASUREMENTS

For risetime and falltime measurements, the 10% and 90% amplitude points are used as starting and ending reference points.

Procedure:

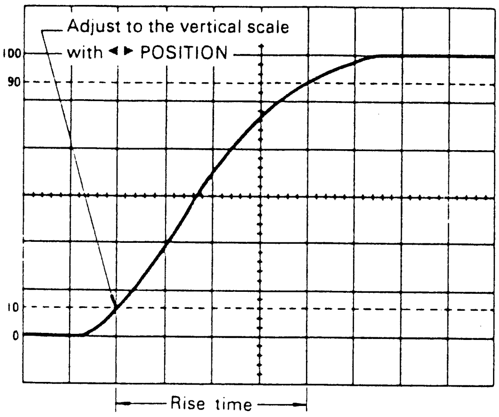
1. Apply a signal to the INPUT and set V MODE to the channel to be used.
   Use VOLTS/DIV and VARIABLE to adjust the waveform peak to peak height to six divisions.
2. Using the ⇕ POSITION control and the other controls, adjust the display such that the waveform is centered vertically in the display. Set the SWEEP TIME/DIV to as fast a setting as possible consistent with observation of both the 10% and 90% points. Set the A VAR to the CAL position.
3. Use the ◀▶ POSITION control to adjust the 10% point to coincide with a vertical graduation line and measure the distance in divisions between the 10% and 90% points on the waveform. Multiply this by the SWEEP TIME/DIV and also by 1/10, if "× 10 MAG" mode was used.

CAUTION

Be sure that the correct 10% and 90% lines are used. For such measurements the 0, 10, 90 and 100% points are marked on the CRT screen.

Using the formula:
Risetime = Horizontal distance (div) × (SWEEP TIME/DIV setting) × " × 10 MAG" value^{-1} (1/10)

APPLICATION



[EXAMPLE]

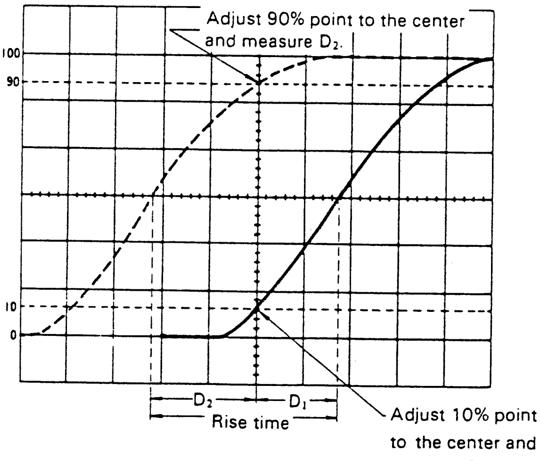
For the example, the horizontal distance is 4.0 divisions. The SWEEP TIME/DIV is 2μs.

Substituting the given value:
Risetime = 4.0 (div) × 2 (μs) = 8μs

Risetime and falltimes can be measured by making use of the alternate step 3' as described below as well.

4. Use the ◄► POSITION control to set the 10% point to coincide with the center vertical graduation line and measure the horizontal distance to the point of the intersection of the waveform with the center horizontal line. Let this distance be D_1. Next adjust the waveform position such that the 90% point coincides with the vertical centerline and measure the distance from that line to the intersection of the waveform with the horizontal centerline. This distance is D_2 and the total horizontal distance is then D_1 plus D_2 for use in the above relationship in calculating the risetime or falltime.

Using the formula:
Risetime = $(D_1 + D_2)$ (div) × (SWEEP TIME/DIV setting)
× " × 10 MAG" value^{-1} + $_1$/10)



[EXAMPLE]

For the example, the measured D_1 is 1.8 divisions while D_2 is 2.2 divisions. If SWEEP TIME/DIV is 2μs we use the following relationship

Substituting the given value:
Risetime = (1.8 + 2.2) (div) × 2 (μs) = 8μs

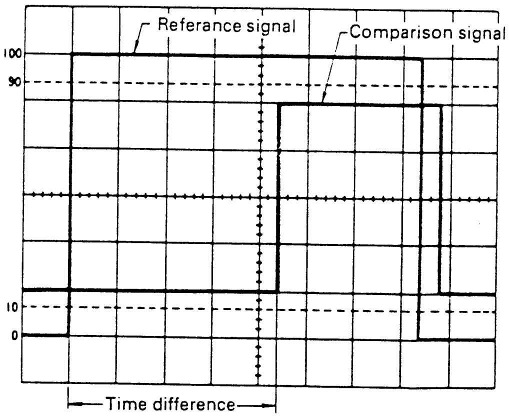
TIME DIFFERENCE MEASUREMENTS

This procedure is useful in measurement of time differences between two signals that are synchronized to one another but skewed in time.

Procedure:

1. Apply the two signals to CH1 and CH2 and set the V MODE to DUAL choosing either ALT or CHOP mode. Generally for low frequency signals CHOP is chosen with ALT used for high frequency signals.
2. Select the faster of the two signals as the SOURCE and use VOLTS/DIV and SWEEP TIME/DIV to obtain an easily observed display.
   Set A VAR to CAL.
3. Using ▲▼ POSITION control set the waveforms to the center of the CRT display and use the ◄► POSITION control to set the reference signal to be coincident with a vertical graduation line.
4. Measure the horizontal distance between the two signals and multiply this distance in divisions by the SWEEP TIME/DIV setting.
   If × 10 MAG is being used multiply this again by 1/10.

   Using the formula:
   Time = Horizontal distance (div) × (SWEEP TIME/DIV setting) × " × 10 MAG" value^{-1} (1/10)



[EXAMPLE]

For the example, the horizontal distance measured is 4.4 divisions. The SWEEP TIME/DIV is 0.2ms.

Substituting the given value:
Time = 4.4 (div) × 0.2(ms) = 0.88ms

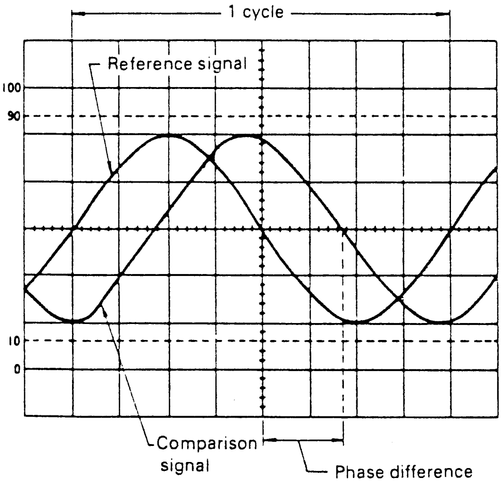
APPLICATION

PHASE DIFFERENCE MEASUREMENTS

This procedure is useful in measuring the phase difference of signals of the same frequency.

1. Apply the two signals to the CH1 and CH2 INPUTS, setting the V MODE to DUAL and choosing either CHOP or ALT mode.
2. Set the SOURCE to the signal which is leading in phase and use VOLTS/DIV to adjust the signals such that they are equal in amplitude. Adjust the other controls for a normal display.
3. Use SWEEP TIME/DIV and A VAR to adjust the display such that one cycle of the signals occupies 8 divisions of horizontal display.
   Use the ⬍ POSITION to bring the signals in the center of the screen.
   Having set up the display as above, one division now represents 45° in phase.
4. Measure the horizontal distance between corresponding points on the two waveforms.

Using the formula:
Phase difference = horizontal distance (div) × 45°/div



[EXAMPLE]
For the example, the horizontal distance is 1.7 divisions.

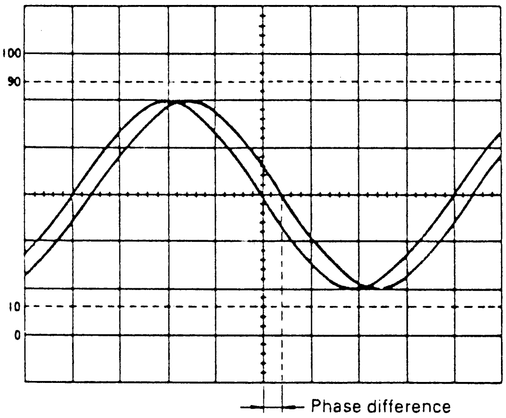
Substituting the given value:
The phase difference = 1.7 (div) × 45°/div = 76.5°

The above setup allows 45° per division but if more accuracy is required the SWEEP TIME/DIV may be changed and magnified without touching the A VAR control and if necessary the trigger level can be readjusted.

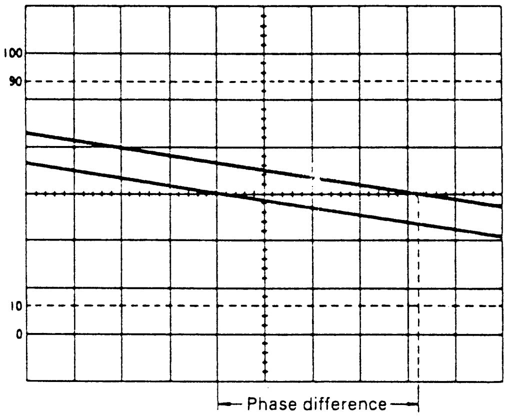
For this type of operation, the relationship of one division to 45° no longer holds. Phase difference is defined by the formula as follow.

$$\text{Phase difference} = \text{horizontal distance of new sweep range (div)} \times 45^\circ/\text{div} \times \frac{\text{New SWEEP TIME/DIV setting}}{\text{Original SWEEP TIME/DIV setting}}$$

Another simple method of obtaining more accuracy quickly is to simply use × 10 MAG for a scale of 1 division = 45°/div



One cycle adjusted to occupy 8 div.



Expanded sweep waveform display.

RELATIVE MEASUREMENTS

If the frequency and amplitude of some reference signal are known, an unknown signal may be measured for level and frequency without use of the VOLTS/DIV or SWEEP TIME/DIV for calibration.
The measurement is made in units relative to the reference signal.

★Vertical Sensitivity

Setting the relative vertical sensitivity using a reference signal.

1. Apply the reference signal to the INPUT and adjust the display for a normal waveform display.

APPLICATION

Adjust VOLTS/DIV and VARIABLE so that the signal coincides with the CRT face's graduation lines. After adjusting, be sure not to disturb the setting of the VARIABLE control.

2. The vertical calibration coefficient is now the reference signal's amplitude (in volts) divided by the product of the vertical amplitude set in step 1 and the VOLTS/DIV setting.

   Using the formula:

   Vertical coefficient

   $$= \frac{\text{Voltage of the reference signal (V)}}{\text{Vertical amplitude (div)} \cdot \text{VOLTS/DIV setting}}$$

3. Remove the reference signal and apply the unknown signal to the INPUT, using the VOLTS/DIV control to adjust the display for easy observation. Measure the amplitude of the displayed waveform and use the following relationship to calculate the actual amplitude of the unknown waveform.

   Amplitude of the unknown signal (V)
   = Vertical distance (div) × Vertical coefficient
   × VOLTS/DIV setting

[EXAMPLE]

For the example the VOLTS/DIV is 1V.
The reference signal is 2 Vrms. Using the VARIABLE, adjust so that the amplitude of the reference signal is 4 divisions.

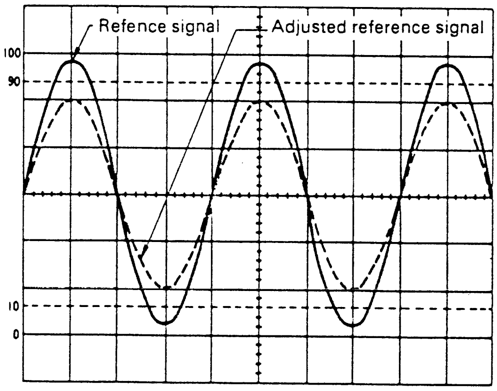
Substituting the given value:

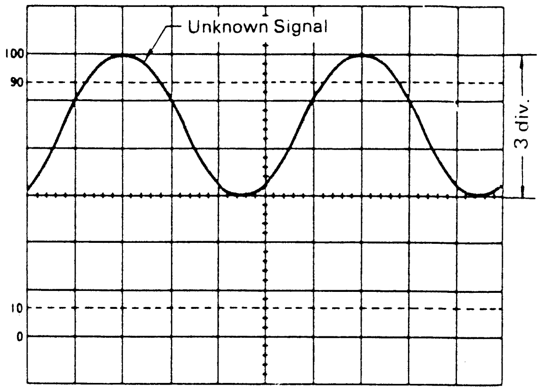
$$\text{Vertical coefficient} = \frac{2\ \text{Vrms}}{4\ \text{(div)} \times 1\ \text{(V)}} = 0.5$$

Then, measure the unknown signal and VOLTS/DIV is 2V and vertical amplitude is 3 divisions.

Substituting the given value:

Effective value of unknown signal = 3 (div) × 0.5 × 5(V)
= 7.5 V rms





★PERIOD

Setting the relative sweep coefficient with respect to a reference frequency signal.

1. Apply the reference signal to the INPUT, using VOLTS/DIV and VARIABLE to obtain an easily observed waveform display.

   Using SWEEP TIME/DIV and VARIABLE adjust one cycle of the reference signal to occupy a fixed number of scale divisions accurately. After this is done be sure not to disturb the setting of the A VAR control.

2. The Sweep (horizontal) calibration coefficient is then the period of the reference signal divided by the product of the number of divisions used in step 1 for setup of the reference and the setting of the SWEEP TIME/DIV control.

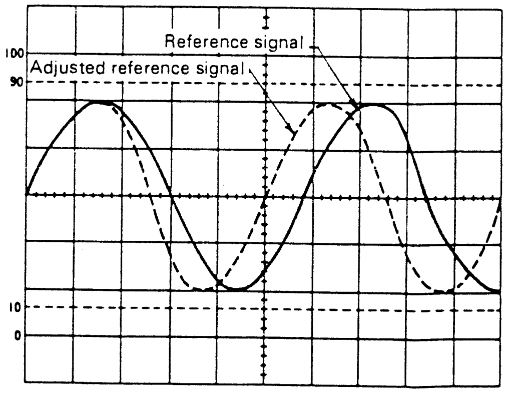
   Using the formula:

   Sweep coefficient

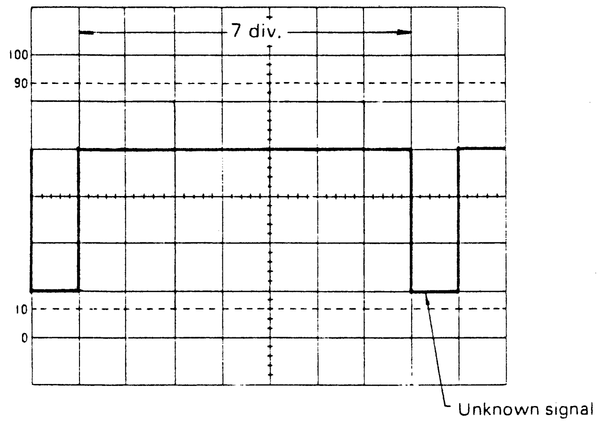
   $$= \frac{\text{Period of the reference signal (sec)}}{\text{Horizontal width (div)} \times \text{SWEEP TIME/DIV setting}}$$

3. Remove the reference signal and input the unknown signal, adjusting the SWEEP TIME/DIV control for easy observation.
   Measure the width of one cycle in divisions and use the following relationship to calculate the actual period.

Using the formula:
Period of unknown signal = Width of 1 cycle (div) × sweep coefficient × SWEEP TIME/DIV setting



APPLICATION



[EXAMPLE]

A SWEEP TIME/DIV is 0.1ms and apply 1.75kHz reference signal. Adjust the A VAR so that the distance of one cycle is 5 divisions.

Substituting the given value:

$$\text{Horizontal coefficient} = \frac{1.75\ (\text{kHz})^{-1}}{5 \times 0.1\ (\text{ms})} = 1.142$$

Then, SWEEP TIME/DIV is 0.2ms and horizontal amplitude is 7 divisions.

Substituting the given value:

Pulse width $= 7$ (div) $\times 1.142 \times 0.2$ (ms) $\fallingdotseq 1.6$ms

PULSE JITTER MEASUREMENTS

1. Apply the signal to the INPUT and set the V MODE to the channel to be used.
   Use VOLTS/DIV to adjust for an easy to observe waveform display. Special care should be taken to adjust the Trigger group of controls for a stable display. Set A VAR to CAL.
2. Set HORIZONTAL DISPLAY to A-INT-B, and pull out the B SLOPE control to affect the STARTS AFTER DELAY mode.
   Adjust the DELAY TIME MULTIPLIER for intensified display of the waveform to be measured.
3. Using the B SWEEP TIME/DIV adjust the display for intensification of the entire jitter area of the waveform.
4. Set the HORIZONTAL DISPLAY to B DLY'D.
   Measure the width of the jitter area.
   The jitter time is this width in divisions multiplied by the setting of the B SWEEP TIME/DIV control.

Using the formula:

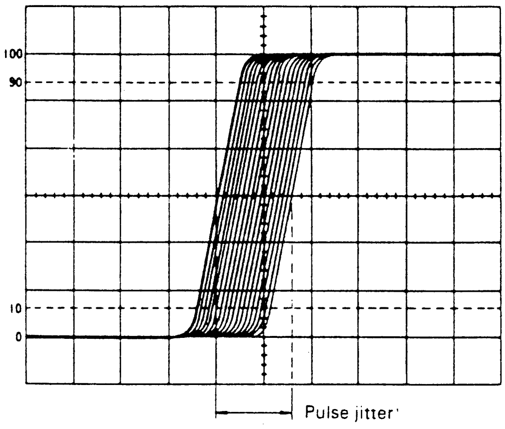
Pulse jitter = Jitter width (div) × B SWEEP TIME/DIV setting

[EXAMPLE]

The example shows a case in which the jitter width was measured at 1.6 divisions wide with the B SWEEP TIME/DIV set at 0.2μs.

Substituting the given value:

Pulse jitter $= 1.6 \times 0.2\mu\text{s} = 0.32\mu\text{s}$



SWEEP MULTIPLICATION (MAGNIFICATION)

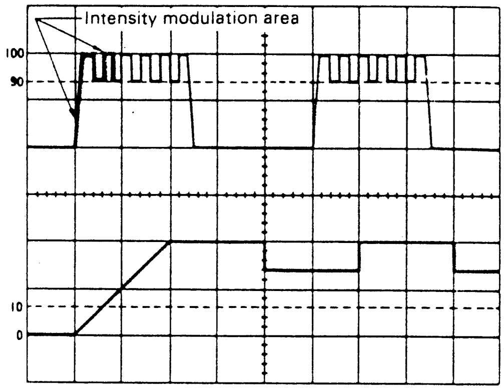
The apparent magnification of the delayed sweep is determined by the values set by the A and B SWEEP TIME/DIV controls

1. Apply a signal to the INPUT and set the V MODE to the channel to be used, adjusting VOLTS/DIV for an easily observed display of the waveform and the other controls if necessary.
2. Set the A SWEEP TIME/DIV so that several cycles of the waveform are displayed. Set the B SLOPE to STARTS AFTER DELAY (pull out).
   When HORIZONTAL DISPLAY is set to A-INT-B, the magnified portion of the waveform will appeared intensified on the CRT display.
3. Use the DELAY TIME MULTIPLIER to shift the intensified portion of waveform to correspond with the section to be magnified for observation. Use the B SWEEP TIME/DIV to adjust intensified portion to cover the entire portion to be magnified.
4. Set the HORIZONTAL DISPLAY to either ALT or B DLY'D and use the ⇕ POSITION and ⇕ TRACE SEP controls to adjust the display for easy viewing.
5. Time measurements are performed in the same manner from the B sweep as was described above for A sweep time measurements.
   The apparent magnification of the intensified waveform section is the A SWEEP TIME/DIV divided by the B SWEEP TIME/DIV.

Using the formula:

$$\begin{array}{l}\text{The apparent magniffication}\\ \text{of the intensified waveform}\end{array} = \frac{\text{A SWEEP TIME/DIV setting}}{\text{B SWEEP TIME/DIV setting}}$$

APPLICATION



[EXAMPLE]

In the example, the A SWEEP TIME is $2\mu s$ and the B SWEEP TIME is $0.2\mu s$.

Substituting the given value:

$$\text{Apparent magnification ratio} = \frac{2 \times 10^{-6}}{0.2 \times 10^{-6}} = 10$$

With the above magnification, if the magnification ratio is increased, delay jitter will occur.
To achieve a stable display, cancel the STARTS AFTER DELAY mode and used the triggered mode of operation.

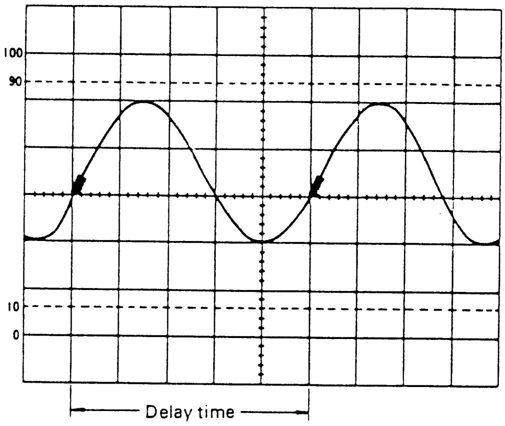
1. Perform the above steps 1 through 3.
2. Press the SLOPE control in to cancel the STARTS AFTER DELAY mode and set the B SOURCE to the same signal as the A trigger source.
3. Set HORIZONTAL DISPLAY to either ALT or B DLY'D. The apparent magnification will be the same as described above.
   If a proper B trigger signal is not applied, intensification may not occur. If this happens, vary the signal level or trigger with an external signal source.

DELAYED SWEEP TIME MEASUREMENTS

Using the B sweep high accuracy time measurements can be made.

1. Apply a signal to INPUT and set the V MODE to the channel to be used. Adjust VOLTS/DIV and the other controls if necessary to obtain an easily observed waveform display.
   Set the A VAR to CAL.
2. Adjust the A SWEEP TIME/DIV to display the portion of waveform to be measured. Pull out the B SLOPE control to set the STARTS AFTER DELAY mode.
   Set HORIZONTAL DISPLAY to A-INT-B and adjust the B SWEEP TIME/DIV for as small as possible an intensified region.
3. Using the ⬍ POSITION control adjust the waveform position so as to intersect with the center horizontal line on the CRT screen. Use the DELAY TIME MULTIPLIER so that the intensified portion of waveform touches the center horizontal line and record the setting of the DELAY TIME MULTIPLIER at this point.
4. Use the DELAY TIME MULTIPLIER to adjust portion of modulation to same point of the second weveform The waveform period is the second dial reading minus the first dial reading multiplied by the A SWEEP TIME/DIV setting.

Using the formula:
Period = (2nd dial reading − 1st dial reading)
× Delayed sweep time (A SWEEP TIME/DIV setting)



[EXAMPLE]

For the example the first dial setting is 1.01 and the second is 6.04. The setting of A SWEEP TIME/DIV is 2ms.

Substituting the given value:
Period = (6.04 − 1.01) × 2 (ms) = 10.06ms

PULSE WIDTH MEASUREMENTS USING DELAYED SWEEP

This method is similar to the time measurement method and can be used for high accuracy pulse width measurements.

1. Apply the pulse signal to the INPUT and set the V MODE to the channel to be used.
2. Use the VOLTS/DIV, VARIABLE and ⬍ POSITION controls to adjust the display such that the waveform is easily observable with the center of the pulse width coinciding with the center horizontal graduation line.
   Set A VAR to CAL.
3. Set the A SWEEP TIME/DIV to display the portion of the waveform to be measured, pulling out the B SLOPE control to set up the STARTS AFTER DELAY mode of display.
   Set HORIZONTAL DISPLAY to A-INT-B, and adjust the B SWEEP TIME/DIV for as short as possible an intensified section of waveform.
4. Using the DELAY TIME MULTIPLIER, adjust the display so that the intensified portion touches the center horizontal graduation line of the CRT screen and record the dial setting at this point.

5. Using the DELAY TIME MULTIPLIER adjust the falling edge of the pulse so that it touches the center horizontal graduation line and is intensified.
   The pulse width is the second dial reading minus the first dial reading multiplied by the A SWEEP TIME/DIV setting.

Using the formula:
Pulse width = (2nd dial reading-1st dial reading)
× Delayed sweep time (A SWEEP TIME/DIV setting)

[EXAMPLE]

In the example, the first dial reading is 0.61 and the second is 5.78 with the A SWEEP TIME/DIV setting at 2μs. Substituting the appropriate values

Pulse width = $(5.78-0.61)\times 2\ (\mu s) = 10.34\mu s$

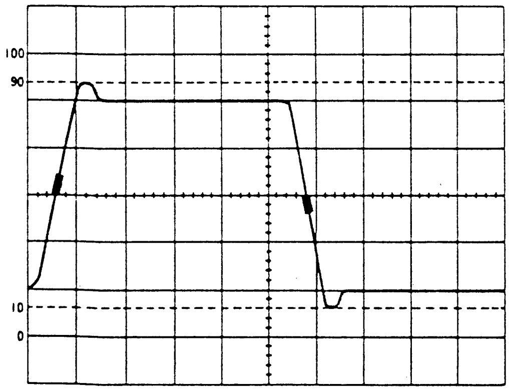
FREQUENCY MEASUREMENTS USING DELAYED SWEEP

The frequency is obtained as the reciprocal of the period of one cycle.

1. Measure the period of the waveform using the procedure described above for time measurement.
2. The frequency is then the reciprocal of the period measured.

Using the formula:

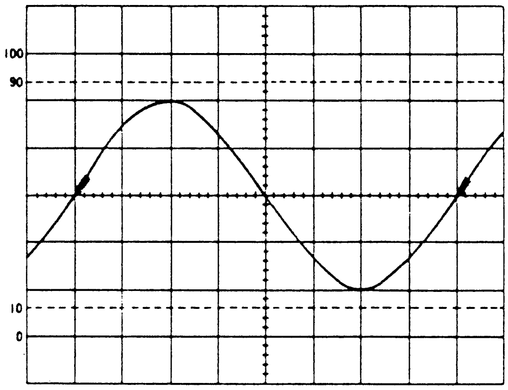
$$\text{Freq} = \frac{1}{\text{Period}}$$



[EXAMPLE]

For the example, the period measured is 40.2μs, making the frequency simply.

Substituting the given value:
Freq = $1/(40.2\times 10^{-6}) \fallingdotseq 24.88$ kHz



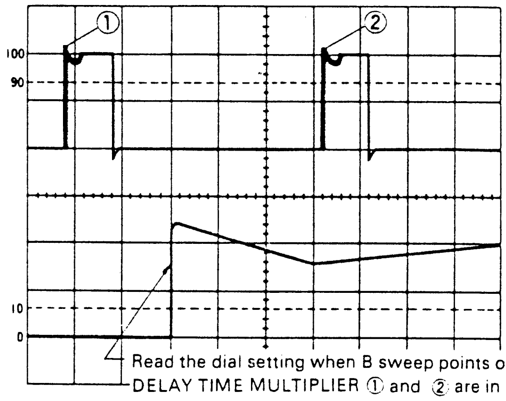
PULSE REPETITION TIME

Using the delayed sweep feature, reliable time measurements can be made.

1. Apply a signal to the INPUT and set the V MODE to the channel to be used.
   Adjust VOLTS/DIV to obtain a normal easy to view display of the waveform.
2. Adjust the A SWEEP TIME/DIV so that at least two cycles of the waveform are displayed.
   Set the HORIZONTAL DISPLAY to A-INT-B and pull out the B SLOPE control to affect the STARTS AFTER DELAY mode of operation.
   Set the B SWEEP TIME/DIV as fast a sweep speed as possible.
3. Using the DELAY TIME MULTIPLIER, adjust the intensified portion to coincide with the first pulse.
   Set the HORIZONTAL DISPLAY to ALT and use ⬍ TRACE SEP to adjust the waveforms for easy viewing.
4. Using the DELAY TIME MULTIPLIER, set the pulse to coincide with one of the vertical graduation lines and record the dial setting at this point.
5. Again using the DELAY TIME MULTIPLIER, adjust the second pulse in the same manner to the vertical line used in step 4, recording this dial setting as well. The pulse repetition time is the second dial reading minus the first dial reading multiplied by the A SWEEP TIME/DIV control setting.

Using the formula:

Pulse repetition time = (2nd dial reading−1st dial reading) × Delayed sweep time (A SWEEP TIME/DIV setting)



Read the dial setting when B sweep points of DELAY TIME MULTIPLIER ① and ② are in the same position.

[EXAMPLE]

For the example, the first dial reading is 0.76 and the second is 6.22 with the A SWEEP TIME/DIV set at 2μs.
We have, substituting the appropriate values

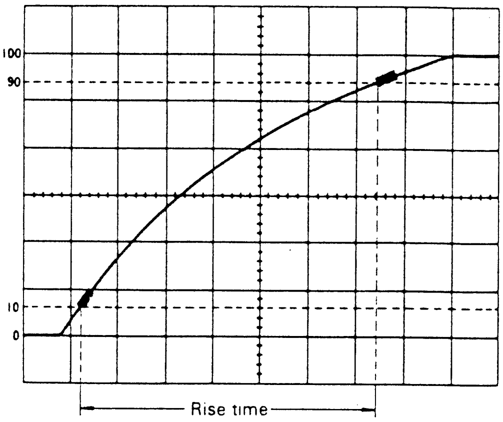
Pulse repetition time = (6.22-0.76) × 2 (μs) = 10.92μs

USING DELAYED SWEEP FOR MEASUREMENT OF RISETIMES AND FALLTIMES

Risetimes and falltimes are generally measured by using the 10% and 90% amplitude points as reference starting and ending points for the rise or fall.

1. Apply the signal to the INPUT and set the V MODE to the channel to be used.
   Use VOLTS/DIV and VARIABLE to obtain a normal 6 division high waveform display.
   Using the ⬍ POSITION control, set the waveform position in the central area of the screen vertically, that it to coincide with the 100% and 0% lines on the CRT screen.
   Set the SWEEP TIME/DIV to as high a speed as possible.
   Set A VAR to the CAL position.
3. Pull out the B SLOPE control to initiate the STARTS AFTER DELAY mode of operation and adjust the B SWEEP TIME/DIV for as short as possible an intensified section of waveform.
4. Using the DELAY TIME MULTIPLIER, adjust the waveform such that the 10% point is intensified and record the dial reading.
5. Similarly, using the DELAY TIME MULTIPLIER adjust the 90% point so that it is intensified and record that dial reading as well.
   The pulse risetime (or falltime) is simply the difference between the two dial settings times the A SWEEP TIME/DIV control setting.

Using the formula
Risetime = (2nd dial reading − 1st dial reading) × Delayed sweep time (A SWEEP TIME/DIV setting)



[EXAMPLE]

For the example, the first dial reading is 1.20 (10% point) and the second is 7.38 (90% point) with the A SWEEP TIME/DIV set at 2μs.

Substituting the given value:

Risetime = (7.38 − 1.20) × 2 (μs) = 12.36μs

TIME DIFFERENCE MEASUREMENTS USING DELAYED SWEEP

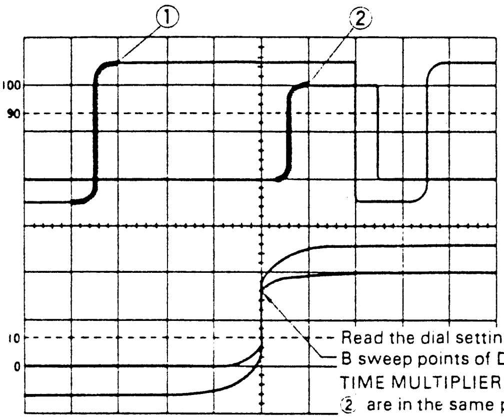
Synchronized waveforms which are skewed in time can be accurately measured using the delayed sweep.

1. Apply the two signals to the CH1 and CH2 INPUTs, setting the V MODE to DUAL and selecting either ALT or CHOP display.
2. Set the SOURCE to the signal that is leading in phase and adjust VOLTS/DIV and SWEEP TIME/DIV for easy waveform observation.
   Set the A VAR control to CAL.
3. Pull out the B SLOPE control to initiate the STARTS AFTER DELAY mode of operation. Set HORIZONTAL DISPLAY to A-INT-B and adjust the B SWEEP TIME/DIV and DELAY TIME MULTIPLIER to make the intensified portion coincide with the rising edge or falling edge of the waveform that is to be used as the reference.
4. Set the HORIZONTAL DISPLAY to ALT and use the ⬍ TRACE SEP control to adjust the B sweep for easy observation.
5. Using the DELAY TIME MULTIPLIER adjust the pulse to any convenient vertical graduation line and record the dial reading at that point.
6. Using the DELAY TIME MULTIPLIER adjust the corresponding point on the second signal to the same vertical line and record the reading of the dial at this point as well. The time difference or skew of the two waveforms is then the second dial reading minus the first dial reading multiplied by the A SWEEP TIME/DIV control setting.

APPLICATION

Using the formula:

Time difference = (2nd dial reading — 1st dial reading) × Delayed sweep time (A SWEEP TIME/DIV setting)


①
②
100
90
10
0

Read the dial setting when B sweep points of DELAY TIME MULTIPLIER ① and ② are in the same position.

[EXAMPLE]

The reference signal dial reading is 1.00 while the second dial reading is 5.34 with an A SWEEP TIME/DIV setting of 2μs.

Substituting the value:

Time difference = (5.34 — 1.00) × 2(μs) = 8.68 μs

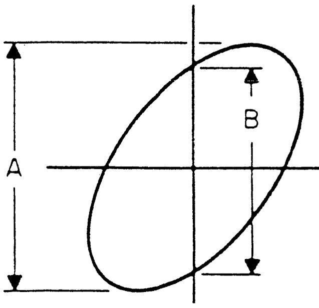
X-Y OPERATION

PHASE MEASUREMENT

Phase measurements may be made with X-Y operation. Typical applications are in circuits designed to produce a specific phase shift, and measurement of phase shift distortion in audio amplifiers or other audio networks. Distortion of amplitude is also displayed in the oscilloscope waveform.

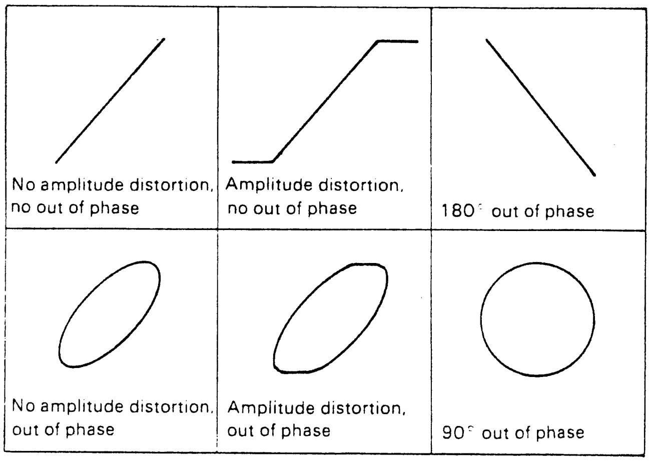
To make phase measurements, use the following procedure

1. Using an audio signal generator with a pure sinusoidal signal, apply a sine wave test signal at the desired test frequency to the audio network being tested.
2. Set the signal generator output for the normal operating level of the cirucit being tested. If desired, the circuit's output may be observed on the oscilloscope. If the test circuit is overdriven, the sine wave display on the oscilloscope is clipped and the signal level must be reduced.



$$\text{SINE } \emptyset = \frac{B}{A}$$

WHERE Ø = PHASE ANGLE


No amplitude distortion, no out of phase
Amplitude distortion, no out of phase
180° out of phase
No amplitude distortion, out of phase
Amplitude distortion, out of phase
90° out of phase

3. Connect the Channel 1 probe to the output of the test circuit.
4. Set the H. DISPLAY to X-Y.
5. Connect the Channel 2 INPUT probe to the input of the test circuit.
6. Adjust the Channel 1 and 2 gain controls for a suitable viewing size.
7. Some typical results are shown above. If the two signals are in phase, the lissajous' pettern is a straight diagonal line. If the vertical and horizontal gain are properly adjusted, this line is at a 45° angle.

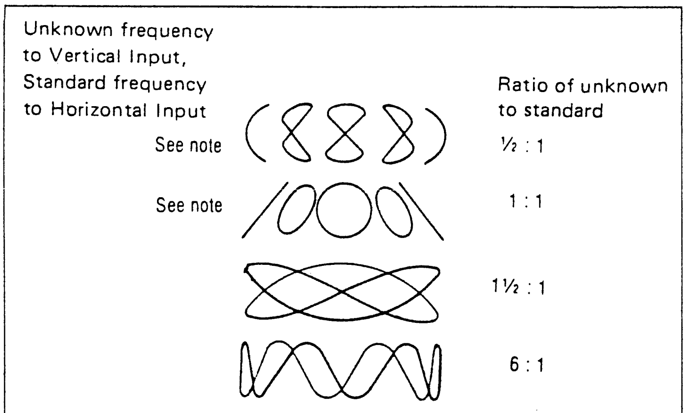
A 90° phase shift produces a circuilar Lissajours' pattern. Phase shift of less (or more) than 90° produces an elliptical Lissajous' pattern. The amount of phase shift can be calculated from the oscilloscope trace as shown left below.

FREQUENCY MEASUREMENT

Frequency measurement may be mode with the Lissajous' pattern, as phase measurement.

Procedure:

1. Connect the sine wave of known frequency to the CH 2 INPUT of the oscilloscope and set the H. DISPLAY to X-Y.
2. Connect the vertical input probe (CH 1 INPUT) to the unknown frequency.
3. Adjust the Channel 1 and 2 gain controls for a convenient, easy-to-read display.
4. The resulting pattern, called a Lissajous pattern, shows the ratio between the two frequencies.


Unknown frequency to Vertical Input, Standard frequency to Horizontal Input
Ratio of unknown to standard
See note
½ : 1
See note
1 : 1
1½ : 1
6 : 1

Note: Any one of these figures, depending upon phase relationship

APPLICATION

4-CHANNEL APPLICATION

The sensitivities of CH1 to CH4 are calibrated and each channel has 100 MHz band width. The trigger signals of CH3 and CH4 can be obtained from each preamplifiers. This unit can be used not only for external synchronization but also for checking 4-Channel at a time.

Application

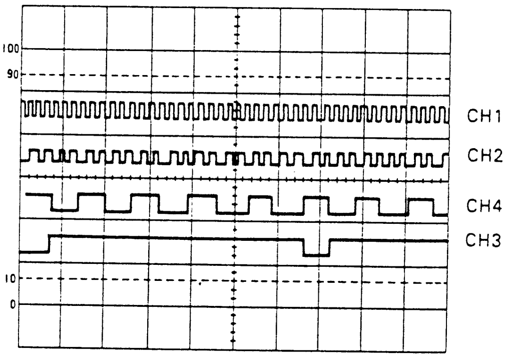
1. Checking logic signal timing
2. Monitoring video signal
3. Measuring audio signal gain and phase characteristics

The details of the logic signal timing checking are described below.

Logic signal timing indication

Control setting
V. MODE: QUAD, ALT A. SOURCE: CH3
H. DISPLAY: A

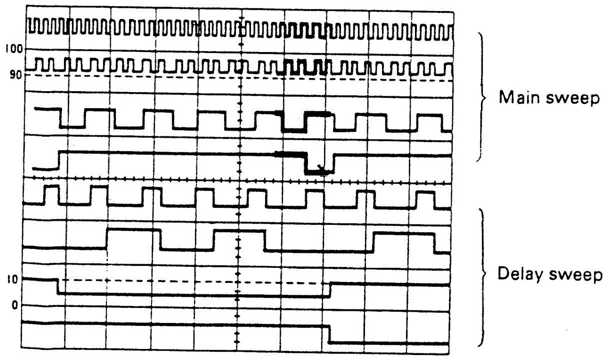
To obtain stable synchronization, synchronize with the longest period channel (in this case, CH3).



In the above application, when the H. DISPLAY control is set to ALT, the main and delay sweep waveforms are displayed on the CRT at a time. The portion in which the intensity is modulated is enlarged to enable easy checking.

Main and delay sweep waveforms (Magnified by 10 times)

Control setting
V. MODE: QUAD, ALT
A. SOURCE: CH3
H. DISPLAY: ALT
STARTS AFTER DELAY: PULL (ON)



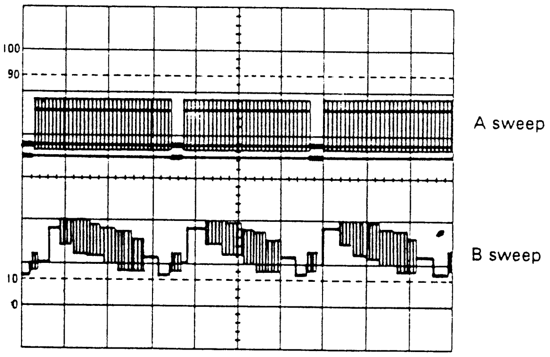
DUAL SWEEP APPLICATION

In this mode, two trigger sweep circuit systems can display different period signals without intensity difference.

Video FRAME and LINE signal waveforms

Control setting
Input signal: CH1 V. MODE: CH1
H. DISPLAY: DUAL A. TRIG SOURCE: CH1
A. COUPLING: VIDEO B. TRIG SOURCE: CH1
B. COUPLING: AC A SWEEP TIME/DIV: 5ms
B. SWEEP TIME/DIV: 20μs

In one waveform display mode, the A and B. TRIG. SOURCE control operation is as described in the front panel. For two or four waveform display mode, refer to the next item.

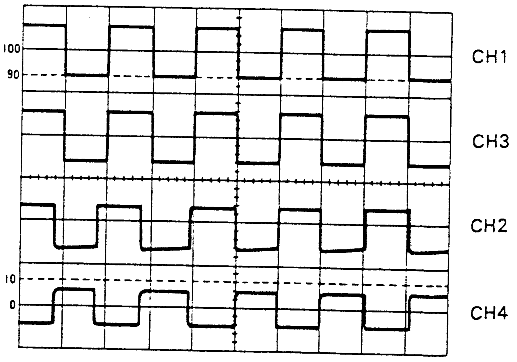


Divider circuit waveforms

Control setting
V. MODE: QUAD, ALT H. DISPLAY: DUAL
A. SOURCE: CH1, B. SOURCE: CH2
A. SWEEP TIME/DIV: 5ms
B. SWEEP TIME/DIV: 0.5μs
CH1 and CH3: 100 Hz signal input
CH2 and CH4: 1 MHz signal input

With this method, when the sweep ratio is set to 10,000 times, the intensity does not change and different period waveform can be synchronized.

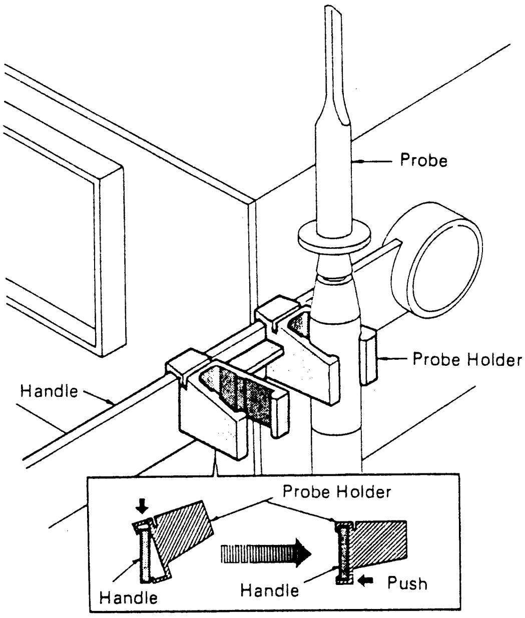
When H. DISPLAY control is set to DUAL and two or four waveforms are displayed, the CH1 and CH3 waveforms are displayed in A sweep mode and CH2 and CH4 waveforms are displayed in B sweep mode. Therefore, adjust the A and B. TRIG SOURCE control accordingly.



ACCESSORY, OPTION

INSTALLING PROBE HOLDER

1. The probe holder is installed in the metal portion of the handle and catches the probe shaft.
2. To install the probe holder, engage the upper two claws with the handle and then engage the lower claw.
3. According to the probe shaft thickness, the probe can be attached as shown below.
4. To remove the probe holder, disengage the lower claw first.

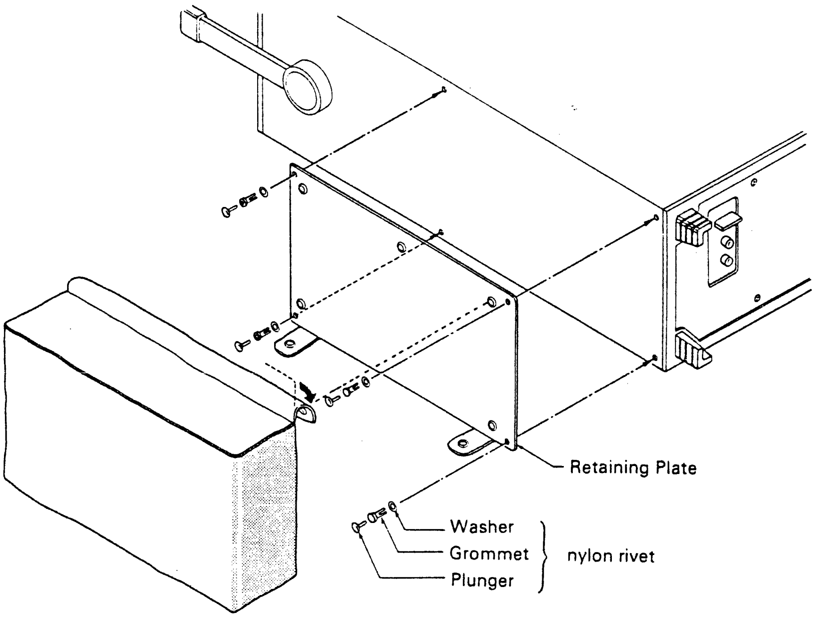

Probe
Probe Holder
Handle
Probe Holder
Handle
Handle
Push

INSTALLING ACCESSORY BAG (OPTION)

1. Detach the hock and separate the accessory bag and retaining plate.
2. When viewed from the front, align the four case right side holes with those of the retaining plate and fix the retaining plate with 4 nylon rivets and 4 washers.

   At this time, confirm that the retaining plate is installed grommet and insert the plunger.

   To remove the nylon rivet, wrench out the plunger with a ⊖ screwdriver.
3. Then mount the accessory bag to the retaining plate with hook.


Retaining Plate
Washer
Grommet
Plunger
nylon rivet

CIRCUIT DESCRIPTION

VERTICAL ATTENUATOR

The CS-2100 input attenuator consists of two stages of attenuation-on having 1/2, 1/4 and 1/10 steps and the other having either 1/10 or 1/100 attenuation to form an overall ten point attenuator in 1-2-5 sequence.
The signal from the attenuator is passed to a dual FET impedance conversion circuit (Q1). Its output is sent to IC12. Variable gain is achieved by varying the emitter resistance of IC12.
The output of IC12 is sent to the vertical pre-amp.
The arrangement for CH2 is the same as for CH1.
Each channel has a 50Ω termination that can be switch selected.

VERTICAL MODE LOGIC CIRCUIT

Instead of the usual mechanical switches used on other instruments the CS-2100 makes use of electronic switching. The switches themselves generate a single pulse output when operated so that the various combinations of switches and holding of selected modes must be done with external logic circuitry. The circuit that accomplishes this is the Vertical Mode Logic Circuit. The pulses generated when the switches are operated are shaped by a schmitt trigger circuit and sent to the rest of the circuitry. IC6 is a latch used to hold a single pulse. The input signal, passing through the circuit formed by D5-D11 and IC3, IC2 and IC7 is a delayed pulse which acts as the trigger for IC6. In this way IC6 holds the data that represents the fact that a switch has been depressed. IC4 acts as a logical single pole double throw switch to select one of DUAL/QUAD and ALT/CHOP. CH2 inverter and 20MHz BW switching functions are managed (ON-OFF) by IC10 which acts as a SPST switch. The output of IC4 is also latched into IC6. The output of IC6 is used to drive the vertical mode LED's through IC8, IC11, IC5 and IC9.

VERTICAL PRE-AMP CIRCUIT

The CS-2100 has four pre-amp circuits to allow 4-channel operation. The output of the vertical attenuator is fed to IC1, an amplifier.
For CH2 an inverting stage, IC2, is provided to allow switched inversion of that channel only. Q2 and Q3 form the CH1 position circuit.
Q50 and Q51 form the CH2 position circuit which operates in a similar fashion to the circuit for CH1. Q4 and Q5 are x1 amplifier stages (for CH1) and Q6, Q7 are x5 amplifier stages. The circuit formed by Q8 and Q9 is used to switch between × 1 and × 5 gain for CH1. For CH2, Q52/Q53 and Q54/Q55 along with Q56 and Q57 have the same functions. Q10/Q11 and Q19/Q20 for a cascoded amplifier.
Q18 and Q21 in combination with Q19 and Q20 form a switching circuit. This circuit is used to turn the CH1 signal on and off.
Q12 and Q13 form the trigger amplifier. The trigger signal passes through the buffer output amplifier formed by Q14 and Q15, being converted to 50Ω impedance and is sent to the A trigger switch circuit. For channel 1 only, the vertical signal passes through the stage formed by Q16 and Q17 to the rear panel connector for CH1 output. The circuit configuration for CH2, CH3 and CH4 is similar except that the CH3 and CH4 position adjustment is accomplished by means of PCB mounted trimmers VR1 and VR2.
The CH1 through CH4 signals are amplified by the output amplifier formed at the base side of the emitter follower formed by Q42 and Q43. This amplifer consists of Q44 and Q45 whose output is sent to the delay line.
Q38/Q39 and Q40/Q41 for the trigger amplifier which sends the signal of the output amplifier to the A trigger switch circuit and acts as the V MODE trigger source. Q37 acts as the load resistance switch for the ADD mode. Q33-Q36 form the 20MHz bandwidth circuit which limit the vertical bandwidth to −3dB down at 20MHz.
CH1 through CH4 signals are switched by the logic circuit formed by IC3 - IC7 in accordance with the vertical mode and horizontal mode selected.

VERTICAL OUTPUT AMPLIFIER

The signal from the delay line is sent to the vertical output amplifier. Q1, Q2, Q3 and Q4 form a cascoded differential input amplifier. Q11 forms a bias current stabilization circuit which in conjuction with Q12 forms the beam finder circuit.
Q7 −Q10 form the final output stage.
Q5 forms the trace separation circuit.

A TRIGGER SWITCH CIRCUIT

The CH1-CH4, V MODE signals are sent to the A trigger switch circuit. S1 is the trigger source switch with S2 acting as the trigger coupling selection switch. Q1 and Q2 form the FIX synchronization circuit, which detects the peak value of the signal and acts as an automatic trigger level control.
Q3 and Q4 form the VIDEO sync circuit which detects the trigger signal of the TV picture signal for stable display.
Q6 and Q7 form an impedance converting emitter follower circuit to lower the output impedance to drive the next stage. Q8 and Q9 form a circuit which is used to improve the CMRR. This circuit is a feedback amplifier. IC1 is a cascode amplifier used as the polarity reversal (inversion) circuit for the trigger signal. Q10 forms an impedance conversion stage used to convert the output of the IC1 stage to 50Ω for output to the horizontal sweep unit.

B TRIGGER SWITCH CIRCUIT

Basically this circuit operates as does the A trigger switch circuit. Q1 accepts the CH2 trigger input and uses this signal to form the X signal for X-Y operation. Other aspects of operation are the same as the A trigger switch circuit.

CIRCUIT DESCRIPTION

SWEEP ROTARY CIRCUIT

Because part of the sweep circuit is packaged on a separate PCB the sweep rotary switch and regulated power supply for the sweep circuit are packaged separately. Q2 and Q3 are control transistors, Q4 is the error voltage detection transistor and Q1 the over-current control transistor.

HORIZONTAL SWEEP CIRCUIT

Horizontal sweep circuit relies on charging a capacitor with a constant current to obtain a sawtooth waveform. Q8 — Q12 form the A sweep time resistance switching circuit. For the B sweep this function is performed by Q38 — Q42 in the same manner Q16 — Q21 form the circuit that switches the holdoff capacitor. For B sweep, this function is performed by Q45-Q49. Q13, Q14 and Q15 form the circuit that switches the sweep time capacitors.

For the B sweep this function is managed by Q43 and Q44 in the same manner. The voltage supplied by the rotary switch circuit's rugulated voltage supply is converted to a regulated current by means of IC11 and Q4 — Q6 forming the voltage setting circuit and resistance values switched by means of Q8 — Q12.

This current is used to charge the sweep time capacitor and result in a rise in the voltage at the capacitor terminals. That voltage is sent to a high impedance buffer amplifier formed by Q24 — Q27. When the output of this amplifier reaches a set value, Q28 turns ON. The output of Q28 is fed to a schmitt trigger circuit formed by IC3d, sent then to the gate formed by IC3b and then used to set the flip-flop, IC2b as well as set IC2a simultaneously. The output of IC2 turns Q7 ON which causes the sweep time capacitor to be shorted resulting in a drop to 1V of the voltage at its terminals. The output of IC2a serves to cancel the shorted condition for the holdoff capacitor. Simultaneous with this, the regulated voltage circuit formed by Q22 is used to charge one capacitor from the group C17-C22. The terminal voltage of the capacitor gradually increases until it reaches a set value, at which point Q23 is turned ON. Q23's output is used to turn ON the schmitt trigger formed by IC4b and fed to gate IC3a which resets IC2b. The output of IC2b cancels the set condition of IC2a beginning the next sweep.

The trigger signal passes through Q80, Q1, IC13 and IC14 to trigger IC2a and cancel the set condition of the flip-flops and initiate a sweep synchronous with the trigger signal occurance.

The trigger signal rectified by IC13 is applied to Q2 and Q3.

When the trigger signal is applied, the gate of IC1b closes and IC2a acts as a master-slave flip-flop.

When the trigger signal disappears, the gate of IC16 opens and the IC2a acts as an R-S flip-flop. This operation is referred to as an auto free run circuit.

Q30 — Q32 form the delayed sweep level detection circuit which turns Q30 when the voltage set by the delay multiplier dial is reached triggering gate IC5a.

IC5a and IC5b form a logical differentiation circuit which generates a fixed whidth pulse. This pulse is used to reset IC7b and start the B sweep.

The configuration of the B sweep circuit is almost the same as for the A sweep circuit. It differs in that it has no autofree-run circuit and lacks the bottom three lowest sweep time ranges.

However, due to the B STARTS AFTER DELAY switch, the gate of IC6d is switched from a master-slave flip-flop to an R-S flip-flop and the sweep can be started from the voltage level set by DELAY TIME MULTIPLIER.

Q57 and Q60 are used to adjust the A and B sweep positions respectively with the sweep mode via the control transistors Q58—Q62. A and B sweep waveforms are formed at the collectors of Q58 and Q62. For X-Y operation the signal also passes through Q63. The signal then passes through the circuit formed by Q66 and to Q68 and Q69 where CMRR is improved before sending it to the next stage. In the next stage, Q70 and Q71 form a X1 amplifier with Q77 and Q72 and Q73 form a X10 amplifier with Q76. Q74 and Q75 are then used to convert impedance to 50Ω before being fed to the final horizontal amplifier.

The trace separation circuit is made up of Q64 and Q65 which provide a double bias voltage to the vertical amplifier in sync with the A and B sweep timing signals. Q29 and IC4d generate a reset pulse for single sweep operation. The remaining IC's form the gating circuits for sweep mode switching.

HORIZONTAL MODE CONTROL CIRCUIT

The switch states are latched by IC4 and IC7 which effectively makes these non-locking switches into locking types functionally.

For horizontal display D1-D9 and IC1d—IC1f are used to hold 3 bits of coded status information. Waveform shaping is used in the IC1 circuit to prevent misoperation. Diodes D10—D12 and IC2c—IC2e and IC3d form a circuit that is used to detect what switch of the horizontal group has been depressed.

The detected switch data is entered into the register IC4 which then holds the switch status. IC5 is a tri-state buffer. IC6 is used to restore the encoded switches status information on a one to one basis for all functions. Switch status held until a particular switch is pressed for a second time. The output of IC6 is used to drive an LED and as a control signal for blanking and sweep switching. The operation of the trigger mode switch input is the same as for the horizontal display switch group. Diodes D13-D16 and IC1a and IC1b are used to encode 2 bits of switch status information for this switch group after pulse shaping is done. D17, D18 IC2a, IC2b, IC2f and IC3a determine whether an input is present, writing into the register IC7a and IC7b the appropriate status information.

This register holds the switch status encoded information until IC8 is used to cancel, or return the status information based on alternate operation of the switches. Similar to the horizontal display switch group, once depressed a switch mode is maintained until the switch is depressed once more. IC5a, IC5b, and IC5c are tri-state buffers. IC9a, IC9b, and IC9d—IC9f along with Q1—Q3 form buffers for the switch LED's and sweep circuit. The output from the trigger mode reset switch is pulse shaped and sent to the trigger sweep circuit.

This circuit holds data even when the instrument's power supply switch is turned OFF. That control is performed by Q4, D19, D20, IC3 and IC8a.

D19 and D20 form a power supply based on the internal lithium battery for memory backup. IC3b and IC3c detect the power OFF condition and generate a memory save signal. The output of the above circuit forms the set of control signals used to control the vertical mode logic circuitry.

First the blanking control signal for horizontal display is generated by the circuit of IC10a, IC10b, IC10c and IC11b. This signal is combined with the sweep and chop signals using IC12b, IC13a, IC13b, IC14b, IC14c, IC15b and IC15c after which it is impedance converted and sent to the blanking circuit by Q8 and Q9.

The A sweep display can be changed to B sweep display by the HORIZONTAL DISPLAY mode signal supplied from D32-D36.

The channel switching signal for the vertical axis is generated by the circuit comprising D25-D29, IC11a, IC12a, IC13c IC13e, IC14a, IC14d, IC15a, IC16a−IC16d.

Horizontal dislay information is used to generate IC12a control signals by means of the circuit of D22-D24 and IC10d.

IC12a is also used to accept a signal comprised of a signal synchronized to the A sweep and this signal under the control of IC11a to select one of the two signals. This signal is then inverted by IC13e.

The chopping signal is generated by the circuit consisting of diodes D27−D29, IC16a−IC16d. On-Off control of this oscillator is accomplished by the vertical axis mode logic and horizontal mode logic circuits. When this oscillator is in the OFF state, IC13e's signal is input to form the alternate signal.

Except for when the IC16a output is off for single sweep operation, the signal is always present. The output signal from IC14a is fed to the vertical pre-amplifier to form the chopping and alternating signals.

CALIBRATING VOLTAGE CIRCUIT

Q11 and Q12 form a multivibrator circuit which generates a signal which is subsequently converted to a low impedance by means of Q10 for output as the calibration signal. It is also used for creation of a current calibration signal by means of R70 and R71. The current calibration signal is output via a rear panel terminal. IC17 is used to regulate the voltage generated by this calibration circuit.

CH3 and CH4 INPUT CIRCUITS

These circuits consist of an attenuator and buffer amplifier. Q16 drives a relay to switch the attenuation between 1/1 and 1/10. The signal from the attenuator is impedance converted with the circuit formed by Q13a, Q13b, Q14 and Q15 and sent to the vertical pre-amplifier. The operation and configuration of the CH4 circuit is similar to the CH3 circuit.

HORIZONTAL OUTPUT AMPLIFIER

The signal from the horizontal sweep circuit is amplified by the differential amplifier formed by Q1 and Q2. The output signal of this circuit is then passed to the emitter follower circuit formed by Q5 and Q6 for impedance conversion to enable driving the circuit formed by Q7 and Q8. Q9 and Q10 form a voltage regulation circuit which serves as the DC load for Q7 and Q8 respectively with AC peaking performed by means of C15 and C16. Q11 and Q12 form an auto-bias circuit which automatically controls the operating point of the output stage. It also serves as the beam finder circuit such that when the base of Q13 is grounded the operating point of the output stage is lowered, resulting in a shrunken display.

SWITCHING POWER SUPPLY UNIT

Although the CS-2100 is light and compact, and make use of a switching regulator type power supply.

Input of either 100V of 200V is rectified and a smoothing capacitor is used to generate a smooth DC output of approximately 200V.

Next, a power transistor is used to convert this output to an AC voltage which is used to drive a compact type converter transformer. The transformer used has 6 bifilar windings which create six separate outputs which are then rectified and smoothed to provide the supply for the blanking unit directly. One of the outputs is compared with a reference voltage to form an error voltage used for regulation. The error voltage is sent to the error voltage amplifier, the output of which is used to control the base of the power transistor. This output is isolated from the primary by means of a photocoupler.

POWER BLANKING UNIT

The five remaining outputs from the switching regulator power supply are further regulated using a series regulation method. This accomplished with Q1, Q3−Q6. IC1a, IC1b, IC2a and IC2b are error voltage amplifiers. The +20V derived by use of a resistance voltage divider. A conventional high voltage DC-DC converter is used. Q25−Q27 are error voltage amplifiers with Q29 acting as a control transistor. The CS-2100 provides independent A and B sweep intensity controls. This function is implemented by means of the circuit formed by Q13−Q15. Q16 forms the beam finder circuit which allows the beam to be seen even if the intensity control has been inadvertently turned to minimum. Q17 forms the external intensity (Z-axis) modulation circuit which accepts an input and results in brighter displays for increasing inputs.

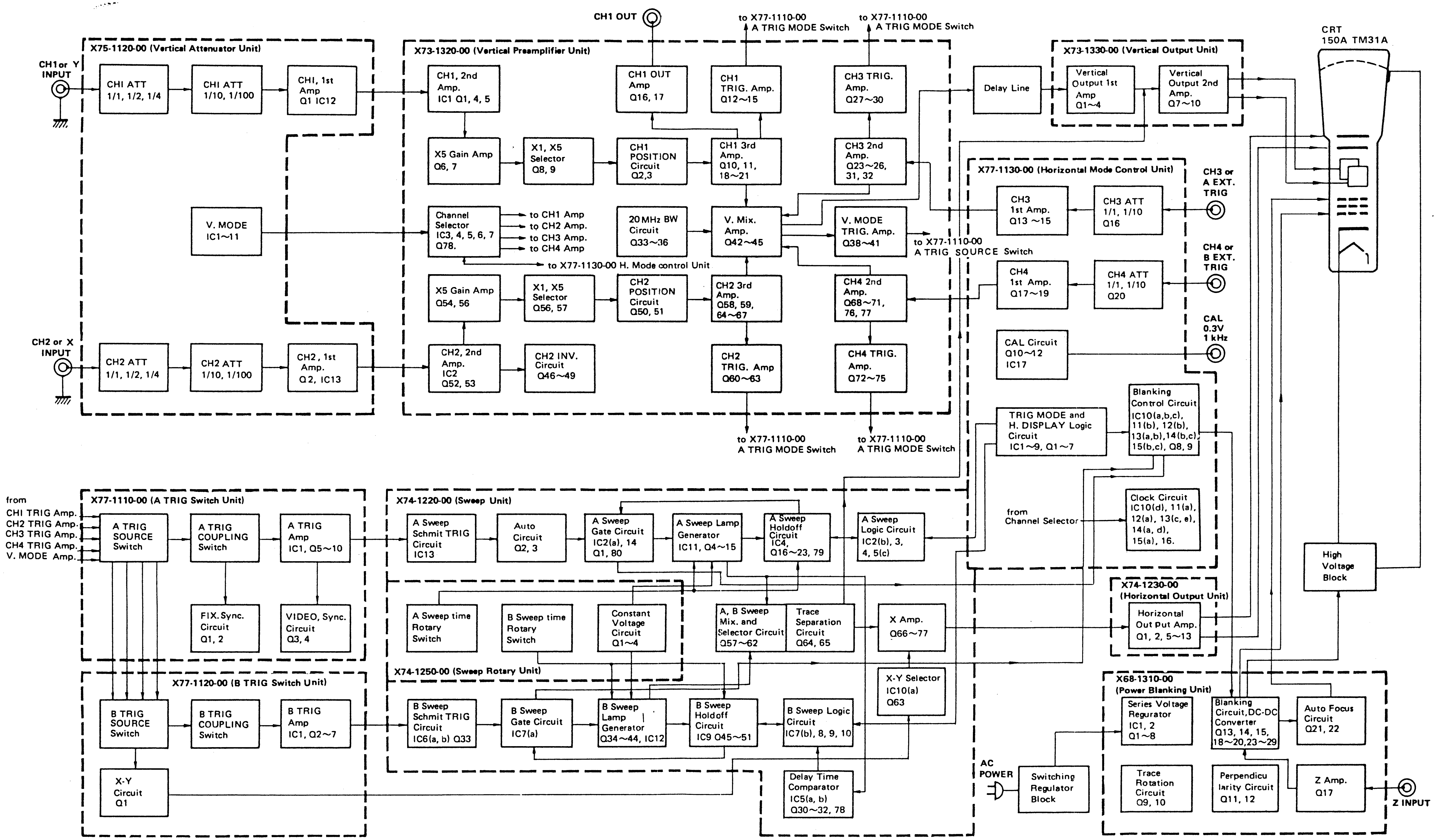
The signals from these circuits are combined at the base of Q18 to drive Q19. Q20 forms the DC load for Q19 with C25 acting to provide AC peaking for this circuit. Q21 and Q22 form the auto-focus circuit which apply a signal to the focus electrodes of a reverse phase from the blanking signal. Q23 and Q24 act to restore the DC component of the blanking and auto-focus circuits by using differential amplifiers for isolation. Q8 controls scale illumination with Q9 and Q10 controlling the adjustment of trace rotation. Q11 and Q12 are used to adjust perpendicularity.

CIRCUIT DESCRIPTION

HIGH VOLTAGE UNIT

The post-acceleration voltage of the CS-2100 is 16kV requiring the high voltage unit to be protected from the hands of the user if safety is to be maintained.
This protection also is required to prevent leakage.
To achieve this goal, the high voltage unit of the CS-2100 has been encapsulated in resin to form a high voltage "block". In the block are the high voltage DC to DC converter as well as the 1.75kV cathode voltage supplies rectifier. In addition to the anode cap which makes available 14kV, the block has 1.75kV DC and 6.3V AC outputs.

BLOCK DIAGRAM

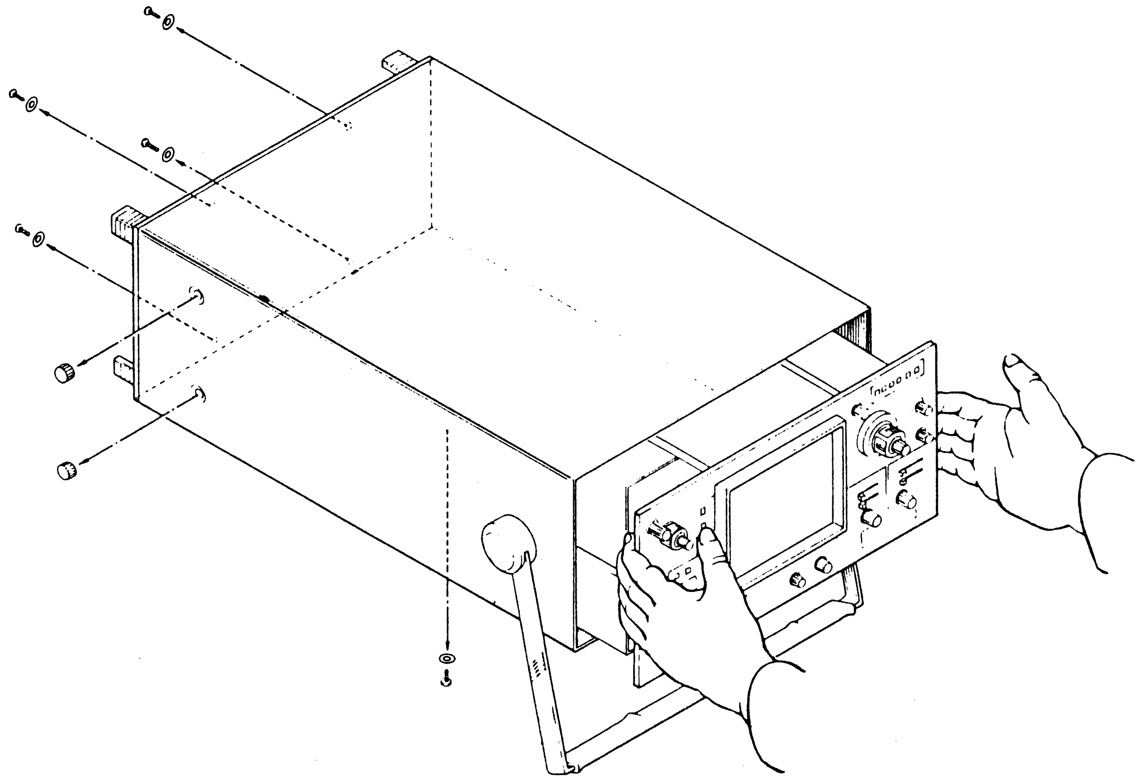

CH1 OUT
to X77-1110-00 A TRIG MODE Switch
to X77-1110-00 A TRIG MODE Switch
CRT 150A TM31A
X75-1120-00 (Vertical Attenuator Unit)
CH1or Y INPUT
CHI ATT 1/1, 1/2, 1/4
CHI ATT 1/10, 1/100
CHI, 1st Amp Q1 IC12
X73-1320-00 (Vertical Preamplifier Unit)
CH1, 2nd Amp. IC1 Q1, 4, 5
CH1 OUT Amp Q16, 17
CH1 TRIG. Amp. Q12~15
CH3 TRIG. Amp. Q27~30
Delay Line
X73-1330-00 (Vertical Output Unit)
Vertical Output 1st Amp Q1~4
Vertical Output 2nd Amp. Q7~10
X5 Gain Amp Q6, 7
X1, X5 Selector Q8, 9
CH1 POSITION Circuit Q2,3
CH1 3rd Amp. Q10, 11, 18~21
CH3 2nd Amp. Q23~26, 31, 32
X77-1130-00 (Horizontal Mode Control Unit)
CH3 or A EXT. TRIG
V. MODE IC1~11
Channel Selector IC3, 4, 5, 6, 7 Q78.
to CH1 Amp
to CH2 Amp.
to CH3 Amp.
to CH4 Amp
20MHz BW Circuit Q33~36
V. Mix. Amp. Q42~45
V. MODE TRIG. Amp. Q38~41
to X77-1110-00 A TRIG SOURCE Switch
CH3 1st Amp. Q13 ~15
CH3 ATT 1/1, 1/10 Q16
to X77-1130-00 H. Mode control Unit
CH4 or B EXT. TRIG
X5 Gain Amp Q54, 56
X1, X5 Selector Q56, 57
CH2 POSITION Circuit Q50, 51
CH2 3rd Amp. Q58, 59, 64~67
CH4 2nd Amp. Q68~71, 76, 77
CH4 1st Amp. Q17~19
CH4 ATT 1/1, 1/10 Q20
CAL 0.3V 1 kHz
CH2 or X INPUT
CH2 ATT 1/1, 1/2, 1/4
CH2 ATT 1/10, 1/100
CH2, 1st Amp. Q2, IC13
CH2, 2nd Amp. IC2 Q52, 53
CH2 INV. Circuit Q46~49
CH2 TRIG. Amp Q60~63
CH4 TRIG. Amp. Q72~75
CAL Circuit Q10~12 IC17
Blanking Control Circuit IC10(a,b,c), 11(b), 12(b), 13(a,b),14(b,c), 15(b,c), Q8, 9
TRIG MODE and H. DISPLAY Logic Circuit IC1~9, Q1~7
to X77-1110-00 A TRIG MODE Switch
to X77-1110-00 A TRIG MODE Switch
from CHI TRIG Amp. CH2 TRIG Amp. CH3 TRIG Amp. CH4 TRIG Amp. V. MODE Amp.
X77-1110-00 (A TRIG Switch Unit)
A TRIG SOURCE Switch
A TRIG COUPLING Switch
A TRIG Amp IC1, Q5~10
X74-1220-00 (Sweep Unit)
A Sweep Schmit TRIG Circuit IC13
Auto Circuit Q2, 3
A Sweep Gate Circuit IC2(a), 14 Q1, 80
A Sweep Lamp Generator IC11, Q4~15
A Sweep Holdoff Circuit IC4, Q16~23, 79
A Sweep Logic Circuit IC2(b), 3, 4, 5(c)
from Channel Selector
Clock Circuit IC10(d), 11(a), 12(a), 13(c, e), 14(a, d), 15(a), 16.
High Voltage Block
FIX.Sync. Circuit Q1, 2
VIDEO, Sync. Circuit Q3, 4
A Sweep time Rotary Switch
B Sweep time Rotary Switch
Constant Voltage Circuit Q1~4
A, B Sweep Mix. and Selector Circuit Q57~62
Trace Separation Circuit Q64, 65
X Amp. Q66~77
X74-1230-00 (Horizontal Output Unit)
Horizontal Out Put Amp. Q1, 2, 5~13
X74-1250-00 (Sweep Rotary Unit)
X-Y Selector IC10(a) Q63
X77-1120-00 (B TRIG Switch Unit)
X68-1310-00 (Power Blanking Unit)
B TRIG SOURCE Switch
B TRIG COUPLING Switch
B TRIG Amp IC1, Q2~7
B Sweep Schmit TRIG Circuit IC6(a, b) Q33
B Sweep Gate Circuit IC7(a)
B Sweep Lamp Generator Q34~44, IC12
B Sweep Holdoff Circuit IC9 Q45~51
B Sweep Logic Circuit IC7(b), 8, 9, 10
Series Voltage Regurator IC1, 2 Q1~8
Blanking Circuit,DC-DC Converter Q13, 14, 15, 18~20,23~29
Auto Focus Circuit Q21, 22
AC POWER
Switching Regulator Block
X-Y Circuit Q1
Delay Time Comparator IC5(a, b) Q30~32, 78
Trace Rotation Circuit Q9, 10
Perpendicu larity Circuit Q11, 12
Z Amp. Q17
Z INPUT

MAINTENANCE

REMOVAL OF CASE

1. Pull out CH3 and CH4 POSITION knobs.
2. Remove the 4 screws located at the rear of the case and the 1 located at bottom with a ⊕ screwdriver. Carefully slide the body forward from the case.
3. To install the body in the case, place the case horizontally and slide the body into the case using the rails located at the bottom of the case. Then, place the body vertically and engage the case front edge into the front panel groove.
4. Temporarily insert the case retaining screws and then tighten them evenly.
5. Install the CH3 and CH4 POSITION knobs.

CAUTION:
A voltage of 16kV is applied to the CRT socket and anode cap. Before removing the case, turn the power off and pull out the power plug. After removing the case, take care not to touch them.



REMOVING/INSTALLING CRT

1. When servicing CRT, do not loosen the CRT band. Only remove the CRT retaining screws, then slide the CRT backward and raise the socket. The CRT can be removed easily.
2. Insert the CRT from the socket side until the CRT comes in contact with the shield plate and tighten the CRT band retaining screws.
3. As slots are provided in the CRT bracket, the CRT can be moved right and left, and back and force.
   As the bracket is inclined by 45°, the CRT can be positioned in an arbitrary position. To fix the CRT, fix the CRT band, then fix the bracket.

CAUTION:
A high tension voltage is remained at the anode of the CRT. Before removing the CRT, connect the anode to the ground via a 100 kΩ load for 5 seconds to discharge the voltage.

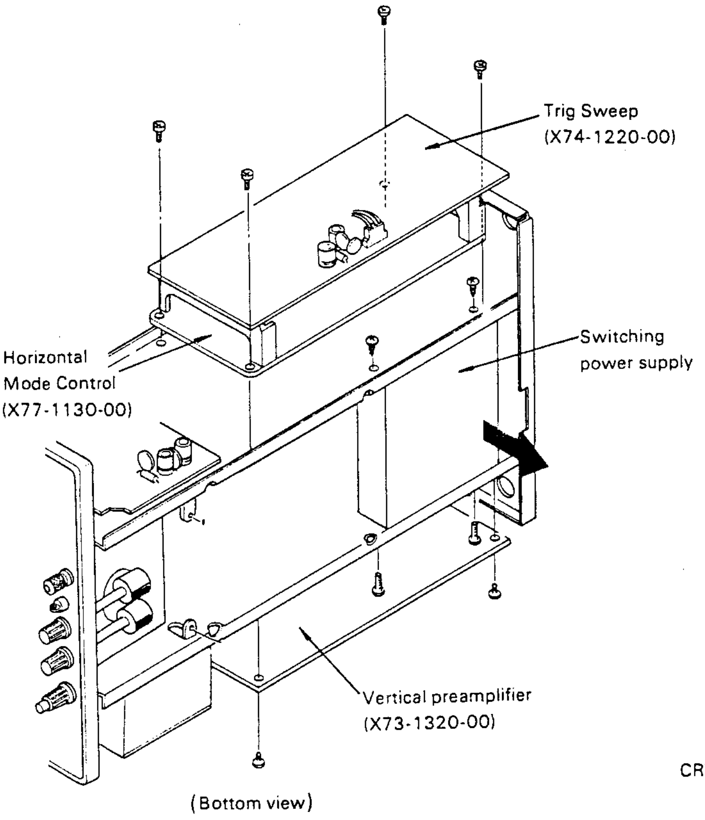
TROUBLESHOOTING

1. Confirm that the voltage selector is set to the correct position.
2. If one of the mode LEDs does not light, the unit will not operate correctly. When using the unit, confirm that the LED lights up.
3. To service the unit effectively, isolate the failure first. Then, remove the case and check the wiring, P.C.B, pattern and parts.
4. A low voltage power supply will affect the circuitry. Do not use the low voltage power supply for checking.

MAINTENANCE

REPLACING SWITCHING POWER SUPPLY

The switching power supply is housed in the shield case located at the rear. To remove the switching power supply, remove the horizontal logic circuitry (right) and vertical preamplifier (left) and remove the retaining screws which fix the shield case to the frame.


Trig Sweep
(X74-1220-00)
Horizontal
Mode Control
(X77-1130-00)
Switching
power supply
Vertical preamplifier
(X73-1320-00)
(Bottom view)

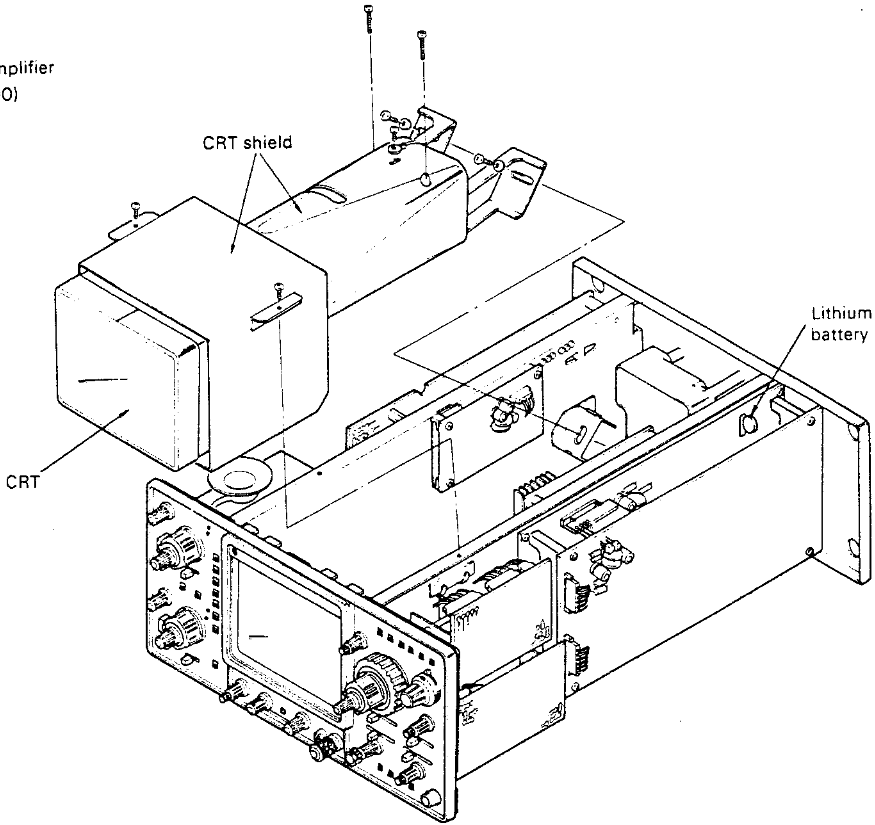
Replacing switching power supply

REPLACING BATTERY

A disc type Lithium battery is installed in the horizontal mode control unit (X77-1130-00). The voltage of the battery is 2.7V. When the voltage drops to 2.0V, replace the battery.

Before replacing the battery, set the unit to the operation mode and confirm that each switch with built-in LED is set correctly.

To remove or install the battery, apply a soldering iron to the parts side of the P.C.B. When installing the battery, observe the polarity. The polarity is indicated on the parts side of the P.C.B.


CRT shield
CRT
Lithium
battery

Removing/installing CRT

ADJUSTMENT

To obtain the best performance, periodically accurately calibrate the unit.

Sometimes, only one mode need be calibrated, while at other times, all modes should be calibrated.

When one mode is calibrated, it must be noted that the other modes may be affected. When calibrating all modes, perform the calibration in the specified sequence.

The following calibration required an accurate measuring instrument and an insulated adjusting flat blade screwdriver. If they are not available, contact your dealer.

For optimum adjustment, turn the power on and warm up the CS-2100 sufficiently (more than 30 minutes) before starting.

CAUTION:

Calibrate the unit under the following condition.
Temperature: 10 — 35°C
Humidity: Less than 85%

POWER SUPPLY VOLTAGE

Before calibrating the unit, check the power supply voltage.

Voltage selector: LOW; 90 — 132V
HIGH; 180 — 264V
50/60 Hz

TEST EQUIPMENT REQUIRED

The following instrument or their equivalent should be used for making adjustments.

Test Equipment	Model	Minimum Specification
Digital Multi-Meter	DL-720 (TRIO)	Impedance: More than 10 MΩ, Measuring range: 0.01V to 199V
Sine-Wave Generator	SG-502 (Tektronix)	Frequency: 10 Hz to 10 MHz, constant voltage over tuning range
Sine-Wave Generator	SG-503 (Tektronix)	Frequency: 50 kHz to 100 MHz, Output impedance: 50Ω, constant voltage over tuning range.
Square-Wave Generator	PG-506 (Tektronix)	Output signal: 1 kHz, Amplitude: 10 mVp-p to 10 Vp-p, Accuracy: within ±1%, Rise time: 35ns or less (1 MHz, 1ns or less)
Q Meter	4343B (YHP)	—
Color Pattern Generator	CG-911 (TRIO)	—
Oscilloscope	475A (Tektronix)	Sensitivity: More than 5 mV Frequency response: More than 250 MHz
Time-Marker Generator	TG-501 (Tektronix)	Time mark: 0.5s to 0.1μs repetitive waveform, accuracy: within 0.1%
High-Voltage Probe	—	Input Impedance: 1000 MΩ
Termination	TA-57 (TRIO)	Impedance: 50Ω
Attenuator	011-0059-02	−20 dB attenuation (50Ω)
Power Meter	2041 (YEW)	—
Auto transformer (variable)	SD-265 (Tektronix)	—
Current Probe	P6302 AM-503 (Tektronix)	—
Frequency Counter	FC-754A (TRIO)	—

PREPARATION FOR ADJUSTMENT

Control Setting

The control settings listed below must be used for each adjustment procedure. Exceptions to these settings will be noted as they occur. After completing a adjustment, return the controls to the following settings.

Power Section

POWER	ON

CRT Control Section

A INTEN	Between 12 and 3 o'clock position
B INTEN	Between 12 and 3 o'clock position
FOCUS	Optimum position
SCALE ILLUM	Arbitrary position
BEAM FINDER	OFF

Vertical Section

VARIABLE (CH1 and CH2)	CAL
▲▼ POSITION (CH1 and CH2)	12 o'clock position
AC-GND-DC (CH1 and CH2)	AC
PUSH 50Ω (CH1 and CH2)	OFF (▬)
VOLTS/DIV (CH1 and CH2)	5V/DIV
× 5 GAIN	OFF

Horizontal Sweep Section

A SWEEP TIME/DIV	0.1ms/DIV
B SWEEP TIME/DIV	0.1ms/DIV
A VAR	CAL
DELAY TIME MULTIPLIER	Arbitrary position
▲▼ TRACE SEP.	Fully CCW
HOLDOFF	NORM
B ENDS A	OFF
◄► POSITION	12 o'clock position
FINE PULL × 10 MAG	12 o'clock position (× 10 MAG OFF)
PULL CHOP F. SELECT	OFF

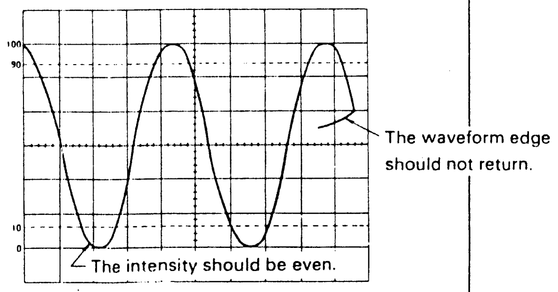
TRIG. Section

A TRIG SOURCE	V. MODE
A COUPLING	AC
A TRIG LEVEL	12 o'clock position
A TRIG SLOPE	+
FIX	(PUSH)
B TRIG SOURCE	CH1
B COUPLING	AC
B TRIG LEVEL	12 o'clock position
B TRIG.SLOPE	+
STARTS AFTER DELAY	(PUSH)

Mode Section

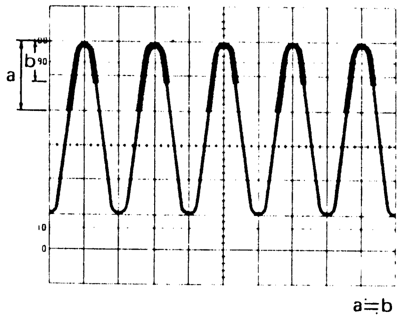
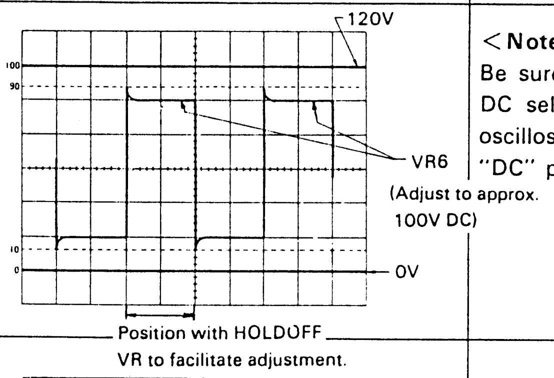
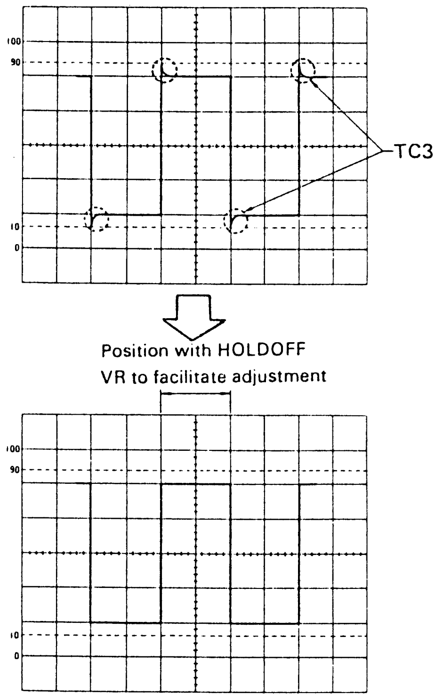
V. MODE	CH1
20MHz BW	OFF
CH2 INV	OFF
TRIG. MODE	AUTO
HORIZONTAL DISPLAY	A

ADJUSTMENT

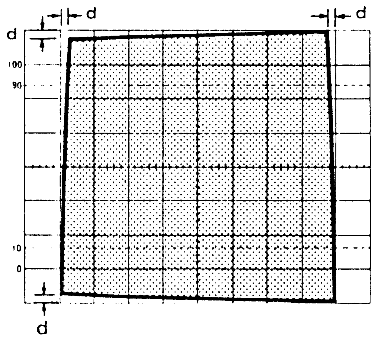
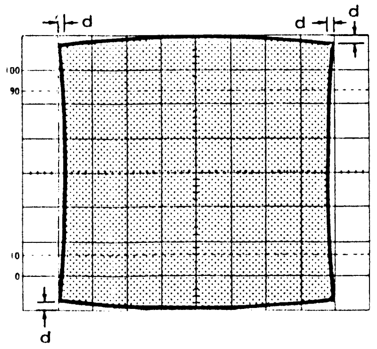
<table>
<tr><th>Item</th><th>Adjustment Control</th><th>P.C.B No.</th><th>Test Equipment</th><th>Control Setting</th><th>Adjustment and Check</th><th>Illustration</th><th>Remark</th></tr>
<tr><td colspan="8">ADJUSTMENT OF POWER SUPPLY AND CRT</td></tr>
<tr><td>Checking of Power Supply</td><td></td><td>X68-1310</td><td>475A
DL-720</td><td></td><td>(1) Measurement and checking of voltages at P27 and P30 pins
<table>
<tr><th></th><th>1P</th><th>2P</th><th>3P</th><th>4P</th><th>5P</th><th>6P</th><th>7P</th><th>8P</th></tr>
<tr><td>P27</td><td>+120V</td><td>+55±1V</td><td>20V</td><td></td><td></td><td>5V</td><td>10V</td><td>−10V</td></tr>
<tr><td>P30</td><td>24V±2V</td><td>55V</td><td>+130V ±3V</td><td></td><td>7V±0.5V</td><td>12V +1.5V −0.5V</td><td>−12V +0.5V −1.5V</td><td></td></tr>
</table></td><td></td><td></td></tr>
<tr><td>Adjustment of 1.7kV</td><td>VR7</td><td>X68-1310</td><td>DL-720
High voltage probe</td><td></td><td>(2) Measure the voltage on 2P of P33 and adjust VR7 to obtain 1.75 kV (1.75kV∼1.755 kV).</td><td></td><td></td></tr>
<tr><td>Coarse adjustment of ASTIG and FOCUS</td><td>VR9
FOCUS Knob</td><td>X68-1310</td><td></td><td>H. DISPLAY: X-Y
CH1, CH2 AC-GND-DC: GND
A INTENSITY: 3 o'clock</td><td>(1) Operate ↕ POSITION knobs for CH1 and CH2 to position the spot in the center of the CRT screen.
(2) Adjust VR9 to make the spot round and smaller.</td><td></td><td></td></tr>
<tr><td>Adjustment of A INTENSITY</td><td>VR5</td><td>X68-1310</td><td></td><td>H.DISPLAY: X-Y
A. INTENSITY: 8 o'clock
CH1, CH2 AC-GND-DC: GND</td><td>Adjust VR5 so that the spot on the CRT screen disappears when A INTENSITY is set in the position of 8 o'clock.
<Check>
(1) Make sure that the spot on the CRT screen increases in brightness when A INTENSITY is turned CW and that the trace becomes almost extinguished when A INTENSITY is turned CCW (8 o'clock position).</td><td></td><td></td></tr>
<tr><td>Checking of B INTENSITY</td><td></td><td></td><td></td><td>H. DISPLAY: ALT
V. MODE: CH1
TRIG. MODE: AUTO
STARTS AFTER DELAY: PULL
CH1, AC-GND-DC: AC
B SWEEP TIME/DIV: 0.1ms</td><td>(1) Operate ↕ TRACE SEP to cause B sweep line in the center of the CRT screen.
(2) Make adjust so that the trace becomes extinguished when B INTENSITY is turned to fully CCW. when B INTENSITY is turned CCW.
(3) Make adjust so that the trace becomes extinguished when B INTENSITY is turned to fully CCW.</td><td></td><td></td></tr>
<tr><td>Adjustment of Blanking</td><td>TC2</td><td>X68-1310</td><td>SG-502</td><td>H.DISPLAY: A
V.MODE: CH1
TRIG. MODE: AUTO
A TRIG SOURCE: V.MODE
A COUPLING: AC
A INTENSITY: Fully CW
CH1. AC-GND-DC: AC
A SWEEP TIME/DIV: 0.02μs</td><td>(1) Apply a sine wave signal of 10 MHz to CH1 INPUT and operate ↕ POSITION, ◂▸ POSITION and CH1 VOLTS/DIV to bring out a waveform with a vertical amplitude of 6 div on the screen.
(2) Make adjustment so that there is no unevenness in intensity of the trace at the waveform starting point and there is no retrace.</td><td>
100
90
10
0
The waveform edge should not return.
The intensity should be even.

</td><td></td></tr>
<tr><td>Adjustment of Z-axis Input Blanking</td><td>TC1</td><td>X68-1310</td><td>SG-503</td><td>H. DISPLAY: A
V. MODE: CH1 :
TRIG. MODE: AUTO
A. TRIG; SOURCE: V. MODE
CH1 AC-GND-DC: DC
VOLTS/DIV: 1V</td><td>(1) Set A SWEEP TIME/DIV at 0.5μs and apply a 1MHz sine wave signal of 5Vp-p to CH1 INPUT so that a waveform with a vertical amplitude of 5 div appears on the screen.
(2) Apply the same signal above to the Z INPUT, and turn A INTENSITY CCW so that the dark and bright area of the waveform are distinct.
(3) Adjust so that the bright area of the sine waveform is symmetrical to the peak point.</td><td></td><td></td></tr>
</table>

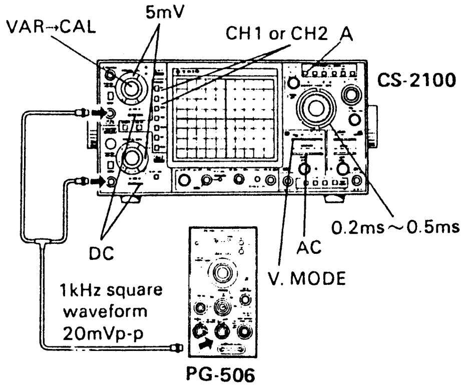
ADJUSTMENT

Item	Adjustment Control	P.C.B No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
							
Adjustment of Auto FOCUS Level	VR6	X68-1310	475A Probe (1/10)	H. DISPLAY: A A. INTENSITY: Fully CW TRIG. MODE: AUTO V. MODE: CH1: A. TRIG SOURCE: V. MODE A. SWEEP TIME/DIV: 20μs HOLDOFF: NORM	(1) Set the oscilloscope (475A) for the vertical axis sensitivity at 2V/div. (2) Observe the waveform of AUTO FOCUS circuit (R55, D9 pattern) with a probe and make adjustment so that DC level of top of the square wave is approx. 100V (4.5～ 5 div.)	 120V 100 90 VR6 (Adjust to approx. 100V DC) 10 0 0V Position with HOLDOFF VR to facilitate adjustment.	< Note > Be sure that the AC-GND-DC selector switch of the oscilloscope (475A) is at "DC" position.
Adjustment of Auto FOCUS wave Forming	TC3	X68-1310		H. DISPLAY: A A INTENSITY: Fully CW TRIG MODE: AUTO V. MODE: CH1 A. TRIG SOURCE: V.MODE A SWEEP TIME/DIV: 20μs HOLD OFF: NORM	Make adjustment so that the above-mentioned circuit has an ideal waveform.	 100 90 TC3 10 0 Position with HOLDOFF VR to facilitate adjustment 100 90 10 0	
Adjustment of ASTIG and FOCUS	VR9 FOCUS knob	X68-1310		H. DISPLAY: X-Y CH1, CH2 AC-GND-DC: GND A. INTENSITY: 3 o'clock	(1) Operate ⬍ POSITION for CH1 and CH2 so that the bright spot is brought into the center of the CRT screen. (2) Make adjustment to make the spot round and smaller. < Check > (1) Make sure that the bright spot grows larger when the FOCUS knob is turned CW or CCW. (2) Make sure that the FOCUS knob is in a position within the range of 9 and 3 o'clock when the spot is smallest. (3) The most ideal point should be obtained by repeating the above operations and adjustment.		< Note > Be sure to bring the bright spot into the center of the CRT screen. It may be difficult to obtain the correct adjusting position near the edge of the screen due to the CRT peripheral blur.

ADJUSTMENT

Item	Adjustment Control	P.C.B No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
Adjustment of Trace Rotation	VR2	X68-1310		H.DISPLAY: A V. MODE: CH1 TRIG. MODE: AUTO CH1, AC-GND-DC; GND	(1) Operate ↕ POSITION for CH1 to move the trace to the center of the CRT screen. (2) Make adjustment to align the trace with the horizontal center graticule line. < Check > (1) Make sure that the trace moves more than 0.5 div (10°) up and down from the horizontal center graticule line at its righthand end.		< Note > When the trace does not appear fully across the screen, make proper adjustment by operating VR9 (X74-1220) and VR1 (X74-1220)
Adjustment of Perpendicularity	VR3	X68-1310	SG-502	H. DISPLAY: X-Y CH1, CH2 AC-GND-DC: AC	(1) Apply a 1 kHz sine wave to CH1 INPUT and adjust the oscillator (SG-502) output to produce a waveform with a vertical amplitude of 8 div. (2) Operate ↕ POSITION knobs for CH1 and CH2 to produce a trace in the center of the CRT screen. (3) Make adjustment so that the trace is vertical (within 90° ±1°) < Check > Make sure that the trace moves more than 0.1 div left and right at the topmost end of the vertical center graticule line. Readjust the trace rotation.		
Check of Pattern Distortion			SG-502	H.DISPLAY: X-Y CH1, CH2 AC-GND-DC: AC	(1) Apply a sine wave signal of 100 kHz to CH1 INPUT and a sine wave signal of 1 kHz to CH2 INPUT and adjust the oscillator output to produce a square with the sides of 8 div on the CRT screen. (2) Check that the horizontal and vertical bendings are less than 0.2 div.	  d= 0.2div. or less	

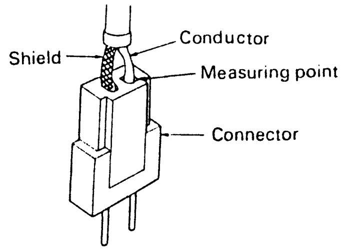
ADJUSTMENT

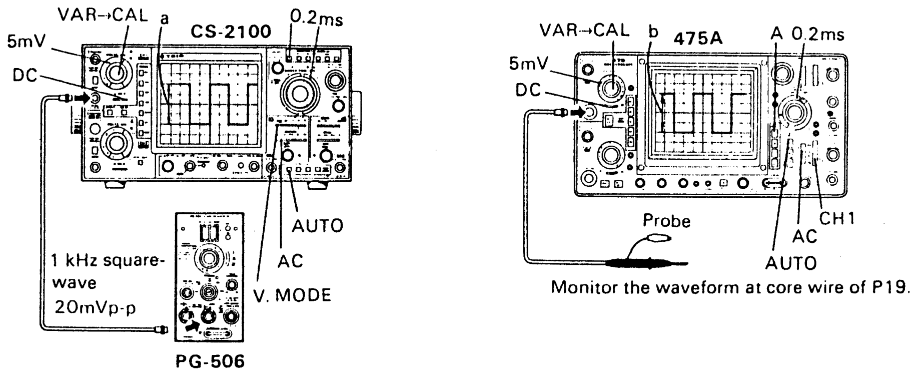
Item	Adjustment Control	P.C.B No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
Adjustment of CRT Center	VR1	X73-1330		H. DISPLAY: A V. MODE: CH1 TRIG. MODE: AUTO CH1. AC-GND-DC: GND	Short-circuit the test point of X73-1320 and adjust VR1 so that the trace becomes aligned with the horizontal center graticule line.		
ADJUSTMENT OF VERTICAL AXIS (I)							
Adjustment of CH1 DC BAL	VR1	X75-1120		H. DISPLAY: A V. MODE: CH1 TRIG. MODE: AUTO CH1. AC-GND-DC: GND CH1. VOLTS/DIV: 5mV	(1) Turn CH1 VARIABLE knob to fully CCW. (2) Adjust CH1 ⬍ POSITION so that the trace becomes aligned with the horizontal center graticule line on the CRT screen. (3) Turn VARIABLE to CAL and make adjustment so that the trace becomes aligned with the horizontal center graticule line on the CRT screen. (4) Repeat the above procedure. **< Check >** Movement of trace | Less than 0.2 div.		**< Note >** If the trace does not come to the center of the screen even when ⬍ POSITION is operated, adjust VR4 (X73-1320).
Adjustment of CH2 DC BAL	VR2	X75-1120		H. DISPLAY: A V. MODE: CH2 TRIG. MODE: AUTO CH2. AC-GND-DC: GND CH2. VOLTS/DIV: 5 mV	Same with the adjustment of CH1 DC BAL		**< Note >** CH2 position center can be adjusted by VR14 (X73-1-320).
Adjustment of CH1 Gain	VR3	X73-1320	BNC-BNC cord T junction PG-506	H. DISPLAY: A V. MODE: CH1 TRIG. MODE: AUTO A. TRIG SOURCE: V.MODE CH1. AC-GND-DC: DC CH1. VOLTS/DIV: 5mV V. VAR: CAL PUSH 50Ω: OFF	(1) Apply a square wave signal of 20 mVp-p, 1 kHz to CH1 and CH2 INPUT. (2) V. MODE select to CH1 and operate CH1 and CH2 ⬍ POSITION to produce a waveform in the center of the CRT screen. (3) Synchronize by operating A TRIG LEVEL. (4) Adjust VR3 so that the vertical amplitude of the waveform becomes 4 div. **< Check >** Turn CH1 VOLTS/DIV and input a reference signal so that the vertical amplitude will be 4 to 6 div in each range. Sensitivity error | within ±3%	 VAR→CAL 5mV CH1 or CH2 A CS-2100 0.2ms～0.5ms DC AC V. MODE 1kHz square waveform 20mVp-p PG-506	**< Refrence >** Method of calculation of sensitivity error Sensitivity error $= \frac{a-b}{b} \times 100\%$ a = CRT screen amplitude b = Input signal voltage /(VOLTS/DIV) (Example): CRT screen amplitude: 4.2 div Input signal: 20mVp-p 1 kHz square wave VOLTS/DIV: 5mV Sensitivity error $= \frac{4.2 \text{ div} - 20\text{mV}/5\text{mV}}{20\text{mV}/5\text{mV}} \times 100 = 5\%$
Adjustment of CH2 Gain	VR13	X73-1320		H. DISPLAY: A V. MODE: CH2 TRIG MODE: AUTO A TRIG SOURCE: V.MODE CH2 AC-GND-DC: DC CH2 VOLTS/DIV: 5mV V. VAR: CAL PUSH 50Ω: OFF	(1) With V. MODE selected to CH2, turn VOLTS/DIV to 5mV and perform the same operations as described above to make adjustment and check. **< Check >** (1) Select V. MODE to DUAL and ALT position and turn VOLTS/DIV for CH1 and CH2 and apply a square wave of 20mVp-p, 1 kHz to CH1 INPUT. Make sure that CH1 and CH2 have the same amplitude.		**< Note >** Overshoot or tilt might appear to the reference signal of 1 kHz square wave. In this case, make corase adjustment of square wave characteristics.

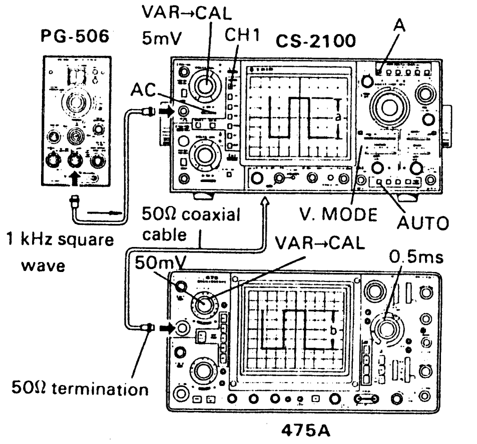
ADJUSTMENT

Item	Adjustment Control	P.C.B No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
					(2) Switch V. MODE to ADD and A. TRIG SOURCE to CH1 (CH2) and press CH2 INV pushbutton switch (the lamp will go on when this switch is pressed and it will go off when pressed again). Operate ⬍ POSITION for CH1 and CH2 to produce a single trace in the center of the CRT screen. If a single and straight trace cannot be obtained, adjust VR3 again. Channel error: Within 3%		
Adjustment of CH1 ⬍ POSITION and CH2 ⬍ POSITION	VR4 VR14	X73-1320 X73-1320		V. MODE: DUAL, ALT H.DISPLAY: A TRIG.MODE: AUTO CH1, CH2 VOLTS/DIV: 5mV CH1, CH2 AC-GND-DC:GND CH1, CH2 ⬍ POSITION: 12 o'clock A SWEEP TIME/DIV: 0.1ms	Adjust VR4 and VR14 so that the CH1 and CH2 traces become aligned with the horizontal center graticule line on the CRT screen. **< Check >** (1) The deviation from the horizontal center graticule line on the CRT screen must be within ±1 div. (2) When ⬍ POSITION for both CH1 and CH2 is turned fully CW, the trace must move upward more than 4 div and when the knob is turned fully CCW the trace must move downward more than 4 div.		
Adjustment of CH2 INV Position	VR15	X73-1320			Press CH2 INV (the lamp is on) and adjust VR15 to bring the trace to its position at CH2 NORM (the lamp is off). **< Check >** (1) Vertical deviation between CH2 NORM and INV : within ±0.5 div (2) Press CH2 INV and turn CH2 ⬍ POSITION fully CW and see if the trace moves more than 4 div upward and it moves more than 4 div downward when the knob is turned fully CCW.		
Adjustment of CH1 X5 Gain and CH2 X5 Gain	VR6 VR17	X73-1320 X73-1320	PG-506	H. DISPLAY: A V. MODE: DUAL, ALT TRIG.MODE: AUTO CH1,CH2 VOLTS/DIV:5mV CH1, CH2 AC-GND-DC: DC CH1,CH2 X5 GAIN: PULL A SWEEP TIME/DIV: 0.2ms V.VAR: CAL CH1,CH2 PUSH 50Ω: OFF	(1) Apply a square wave signal of 5 mVp-p to CH1 INPUT and make adjustment so that the CRT screen amplitude becomes 5 div. (2) Apply the same signal to CH2 and make the similar adjustment. **< Check >** (1) The sensitivity error must be within ±3%. (2) For both CH1 and CH2, the lamp must go on when PULL X5 GAIN is pulled and go off when the button is pressed. (3) The UNCAL lamp must go off when VARIABLE is operated to CAL and go on when the knob is turned to UNCAL. (CCW)		**< Note >** If no waveform appears on the screen when the knob is pulled, make coarse adjustment by operating X5 Gain Position Adjustment. CH1: VR5 (X73-1320) CH2: VR16 (X73-1320)
Adjustment of CH1 X 5 Gain Position andCH2 X 5 Gain Position	VR5 VR16	X73-1320 X73-1320		H. DISPLAY: A V. MODE: DUAL, ALT TRIG. MODE: AUTO CH1,CH2 VOLTS/DIV:5mV CH1,CH2 AC-GND-DC:GND CH1,CH2 X5 GAIN: PULL CH1,CH2 ⬍ POSITION: 12 o'clock A SWEEP TIME/DIV: 0.1ms	Adjust VR5 and VR16 so that the trace of CH1 and CH2 become aligned with the horizontal center graticule line on the CRT screen. **< Check >** The distance from the center graticule line must be within ±1 div.		**< Note >** If sometimes happens that the trace grows thicker at X5 GAIN, thus making it difficult to obtain proper adjustment. In this case, press 20 MHz BW (the lamp is on) button switch to make the line thinner.

ADJUSTMENT

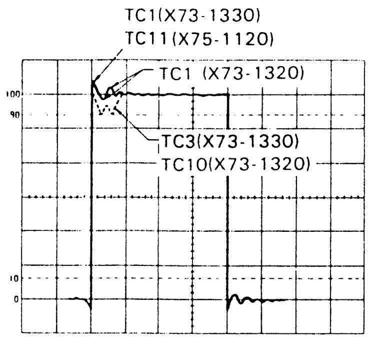
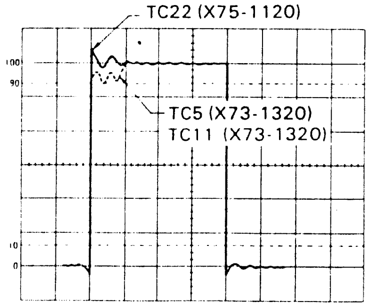
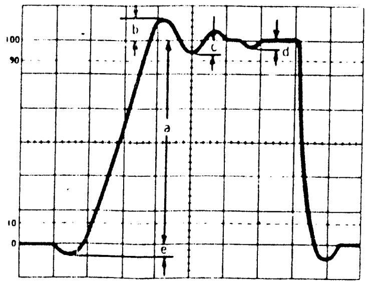
<table>
<tr><th>Item</th><th>Adjustment Control</th><th>P.C.B No.</th><th>Test Equipment</th><th>Control Setting</th><th>Adjustment and Check</th><th>Illustration</th><th>Remark</th></tr>
<tr>
<td>Adjustment of
CH1 DC Trig Level
CH2 DC Trig Level
CH3 DC Trig Level
CH4 DC Trig Level</td>
<td>
VR7
VR19
VR10
VR20</td>
<td>
X73-1320
X73-1320
X73-1320
X73-1320</td>
<td rowspan="2">
DL-720</td>
<td>
H. DISPLAY: A
V. MODE: QUAD
CH1, CH2 AC-GND-DC: GND
TRIG. MODE: AUTO</td>
<td>(1) Operate CH1 and CH2 ⬍ POSITION and CH3 and CH4 ⬍ POSITION to align the trace with each other on the center of the CRT screen.
(2) Make adjustment so that the voltage at all the check points may be zero (−0.008~ +0.008V).
<table>
<tr><th>Item of Adj.</th><th>Adj. Control</th><th>Check point</th></tr>
<tr><td>CH1 DC Trig Level</td><td>VR7</td><td>P15 (X73-1320)</td></tr>
<tr><td>CH2 DC Trig Level</td><td>VR19</td><td>P16 (X73-1320)</td></tr>
<tr><td>CH3 DC Trig Level</td><td>VR10</td><td>P17 (X73-1320)</td></tr>
<tr><td>CH4 DC Trig Level</td><td>VR20</td><td>P18 (X73-1320)</td></tr>
</table></td>
<td>
Shield
Conductor
Measuring point
Connector

</td>
<td><Note>
Use the connector lead for making measurement at the check points.
Adjust the voltage in the conductor to zero.</td>
</tr>
<tr>
<td>Adjustment of
V. MODE Trig DC Level</td>
<td>VR22</td>
<td>X73-1320</td>
<td>V. MODE: CH1
CH1, AC-GND-DC: GND</td>
<td>(1) Operate CH1 ⬍ POSITION to align the trace with horizontal center graticule line on the CRT screen.
(2) Make adjustment so that the voltage in the conductor of the connector P19 is zero (−0.008 ~ +0.008V).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjustment of
V. MODE Trig Gain</td>
<td>VR12</td>
<td>X73-1320</td>
<td>475A
Probe (1/10)
PG-506</td>
<td>H. DISPLAY: A
V. MODE: CH1
CH1, AC-GND-DC: AC
CH1, VOLTS/DIV: 5mV
TRIG. MODE: AUTO
A SWEEP TIME/DIV: 0.2ms</td>
<td>(1) Apply a 1 kHz square wave signal of 20 mVp-p to CH1 INPUT and adjust the oscillator output to produce a waveform of 4 div amplitude on the CRT screen.
(2) Set the vertical axis sensitivity of the oscilloscope (475A) to 5mV to observe the waveform of the conductor of connector P19 (X73-1320) and make adjustment so that the vertical maplitude may be 4 div 200m Vp-p (3.6 ~ 4.4 div).

VAR→CAL
a
CS-2100
0.2ms
5mV
DC
AUTO
AC
V. MODE
1 kHz square-wave
20mVp-p
PG-506
VAR→CAL
b
475A
A 0.2ms
5mV
DC
Probe
CH1
AC
AUTO

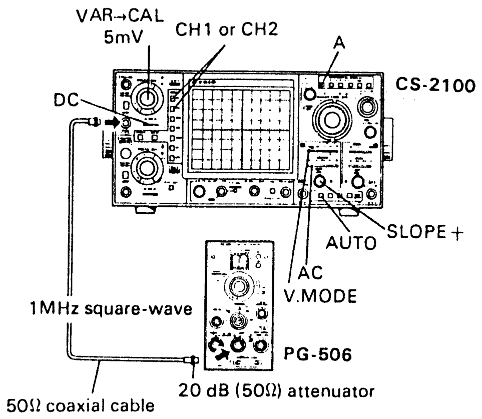
Monitor the waveform at core wire of P19.
a=b=4 div.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjustment of CH1 OUT Gain</td>
<td>VR8</td>
<td>X73-1320</td>
<td>475A
50Ω Termination
50Ω coaxial cable
PG-506</td>
<td>H.DISPLAY: A
V. MODE: CH1
TRIG MODE: AUTO
CH1 AC-GND-DC: AC
CH1 VOLTS/DIV: 5mV
V. VAR: CAL</td>
<td>(1) Set the vertical axis sensitivity of oscilloscope (475A) to 50mV and AC-GND-DC to DC.
(2) Connect the cable to CH1 OUT on the rear panel of CS-2100 and oscilloscope (475A) via the 50Ω termination.
(3) Apply a 1 kHz square wave signal to CH1 INPUT and adjust the oscillator output and ⬍ POSITION so that the amplitude may be 2 div upward and downward from the horizontal center graticule line on the CRT screen.
(4) Make adjustment so that the oscilloscope (475A) waveform becomes 4 div.</td>
<td>
PG-506
VAR→CAL
5mV
CH1
CS-2100
A
AC
50Ω coaxial cable
V. MODE
AUTO
1 kHz square wave
VAR→CAL
50mV
0.5ms
50Ω termination
475A

a=b=4 div.</td>
<td></td>
</tr>
</table>

ADJUSTMENT

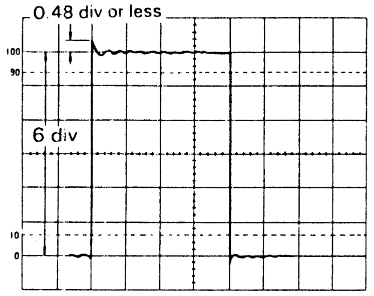
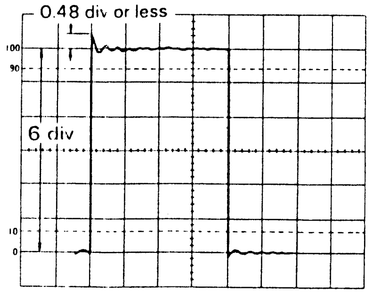
Item	Adjustment Control	P.C.B No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
Adjustment of CH1 OUT DC Level	VR9	X73-1320	DL-720	H.DISPLAY: A V. MODE: CH1 CH1 AC-GND-DC: GND TRIG. MODE: AUTO	(1) Operate CH1 ♦ POSITION to align the trace with the horizontal center graticule line on the CRT screen. (2) Make adjustment so that the voltage in the connector P21 (X73–1320) becomes less than 0V (±10mV).		
Adjustment of Square wave Charactaristics of CH1 5mV Range and CH1 OUT	TC3 TC1 TC10 TC11 TC1 TC9	X73-1330 X73-1320 X73-1320 X75-1120 X73-1330 X73-1330	PG-506 50Ω Termination (Through type) 50Ω 20dB Attenuator 50Ω coaxial cable (BNC-BNC) 475A	H. DISPLAY: A TRIG MODE: AUTO CH1, CH2 AC-GND-DC:DC CH1, CH2 VOLTS/DIV:5mV A TRIG SOURCE: V. MODE COUPLING: AC A TRIG SLOPE: + V VAR: CAL	(1) The knobs on the oscilloscope (475A) should be set VOLTS/DIV to 50mV and AC-GND-DC to DC. (2) Connect the CH1 OUT to the input terminal of oscilloscope (475A) through 50Ω termination. (3) Set V. MODE to CH1 and repeatedly apply a 1 MHz squarewave signal to CH1 INPUT from the squarewave oscillator and adjust the oscillator output so that the amplitude becomes 6 div. In doing this, the input terminal must be terminated to match the output impedance of the oscillator. When the output impedance is 50Ω termination or depress the PUSH 50Ω button. (4) Adjust TC3, TC1, TC10, TC11 and TC1 to shape the square wave on the CRT screen (CS-2100) as illustrated at right. At the sametime, adjust TC9 to shape the square wave on the CRT screen of 475A.	 TC1(X73-1330) TC11(X75-1120) TC1 (X73-1320) TC3(X73-1330) TC10(X73-1320) 100 90 10 0	(1) Adjust A SWEEP TIME/DIV between 0.02 μs and 0.2 μs so that the waveform is visible. (2) As all measuring instruments are affected, repeat the adjustment individually.
Adjustment of Square wave Characteristics of CH2 5mV Range	TC5 TC22 TC11	X73-1320 X75-1120 X73-1320			(1) Set V. MODE to CH2 and make adjustment to obtain the same waveform as in the case of CH1. < Check > (1) With VOLTS/DIV remaining at 5mV, check the waveform quality when A. SWEEP TIME/DIV is changed by varying the squarewave frequency, from 100kHz to 10kHz, 1kHz and back to 100Hz sequentially. Overshoot: Less than 8%	 TC22 (X75-1120) TC5 (X73-1320) TC11 (X73-1320) 100 90 10 0  a = 6 div c = Ringing e = Pre-shoot b = Overshoot d = Hall	

ADJUSTMENT

<table>
<tr><th>Item</th><th>Adjustment Control</th><th>P.C.B No.</th><th>Test Equipment</th><th>Control Setting</th><th>Adjustment and Check</th><th>Illustration</th><th>Remark</th></tr>
<tr>
<td>Adjustment of Square wave Characteristics of CH1 X5 GAIN</td>
<td>TC2</td>
<td>X73-1320</td>
<td rowspan="2">PG-506
50Ω Termination
(Through type)
50Ω, 20dB Attenuator
50Ω coaxial cable
(BNC-BNC)</td>
<td rowspan="2">H. DISPLAY: A
TRIG MODE: AUTO
CH1, CH2 AC-GND-DC: DC
CH1, CH2 VOLTS/DIV: 5mV
A TRIG SOURCE: V.MODE
COUPLING: AC
A TRIG SLOPE: +
V. VAR: CAL</td>
<td>(1) With V. MODE being set to CH1, pull the PULL X5 GAIN and apply 1 MHz squarewave signal to CH1 INPUT to produce a waveform quality of 5 div on the CRT screen.
(2) Make adjustment to improve the waveform quality
< Check >
<table><tr><td>Overshoot</td><td>less than 8%.</td></tr></table></td>
<td rowspan="2">
VAR→CAL
5mV
CH1 or CH2
A
DC
CS-2100
AUTO
SLOPE +
AC
V.MODE
1MHz square-wave
PG-506
50Ω coaxial cable
20 dB (50Ω) attenuator

</td>
<td rowspan="2">< Note >
Terminate the input terminal of oscilloscope to match the output impedance of the oscillator.</td>
</tr>
<tr>
<td>Adjustment of Square wave Characteristics of CH2 X5 GAIN</td>
<td>TC6</td>
<td>X73-1320</td>
<td>(1) With V. MODE set to CH2, apply 1 MHz square wave signal to CH2 INPUT and make the same adjustment as in the case of CH1.
< Check >
<table><tr><td>Overshoot</td><td>less than 8%.</td></tr></table></td>
</tr>
<tr>
<td>Adjustment of
CH1 ATT
CH2 ATT</td>
<td></td>
<td>X75-1120</td>
<td>4343B
PG-506</td>
<td>H.DISPLAY: A
CH1 AC-GND-DC: DC
A TRIG SOURCE: V. MODE
A SWEEP TIME/DIV: 0.2ms
V.VAR: CAL</td>
<td>(1) Shaping of waveform
Apply 1 kHz squarewave signal to CH1 and CH2 INPUT and adjust the oscillator output to produce a waveform of 5~6 div. In doing this, make adjustment so that the waveform quality of each range is equal to that of the 5mV range.
(2) Input capacity
Connect a Q-meter (4343B) to CH1 and CH2 INPUT and make adjustment so that the input capacity of each range is equal to that of the 5mV range.
CH1 Reference range: 5mV Range
<table>
<tr><th>Sequence</th><th>Adjustment</th><th></th><th>Adj. control</th></tr>
<tr><td>1</td><td>50mV range</td><td>Wave Shape</td><td>TC9</td></tr>
<tr><td>2</td><td>0.5V range</td><td>Wave Shape</td><td>TC10</td></tr>
<tr><td>3</td><td>50mV range</td><td>Input Capacity</td><td>TC7</td></tr>
<tr><td>4</td><td>0.5V range</td><td>Input Capacity</td><td>TC8</td></tr>
<tr><td>5</td><td>10mV range</td><td>Wave Shape</td><td>TC4</td></tr>
<tr><td>6</td><td>20mV range</td><td>Wave Shape</td><td>TC5</td></tr>
<tr><td>7</td><td>5V range</td><td>Wave Shape</td><td>TC6</td></tr>
<tr><td>8</td><td>5mV X5 GAIN</td><td>Wave shape Check</td><td>–</td></tr>
<tr><td>9</td><td>10mV range</td><td>Input Capacity</td><td>TC1</td></tr>
<tr><td>10</td><td>20mV range</td><td>Input Capacity</td><td>TC2</td></tr>
<tr><td>11</td><td>5V range</td><td>Input Capacity</td><td>TC3</td></tr>
</table>
CH2 Reference range: 5mV Range
<table>
<tr><th>Sequence</th><th>Adjustment</th><th></th><th>Adj. control</th></tr>
<tr><td>1</td><td>50mV range</td><td>Wave Shape</td><td>TC20</td></tr>
<tr><td>2</td><td>0.5V range</td><td>Wave Shape</td><td>TC21</td></tr>
<tr><td>3</td><td>50mV range</td><td>Input Capacity</td><td>TC18</td></tr>
<tr><td>4</td><td>0.5V range</td><td>Input Capcity</td><td>TC19</td></tr>
<tr><td>5</td><td>10mV range</td><td>Wave Shape</td><td>TC15</td></tr>
<tr><td>6</td><td>20mV range</td><td>Wave Shape</td><td>TC16</td></tr>
<tr><td>7</td><td>5V range</td><td>Wave Shape</td><td>TC17</td></tr>
<tr><td>8</td><td>5mV X5 GAIN</td><td>Wave shape Check</td><td>–</td></tr>
<tr><td>9</td><td>10mV range</td><td>Input Capacity</td><td>TC12</td></tr>
<tr><td>10</td><td>20mV range</td><td>Input Capacity</td><td>TC13</td></tr>
<tr><td>11</td><td>5V range</td><td>Input Capacity</td><td>TC14</td></tr>
</table></td>
<td></td>
<td>< Note >
Be sure to make the adjustment with the shield case being fitted in place.</td>
</tr>
</table>

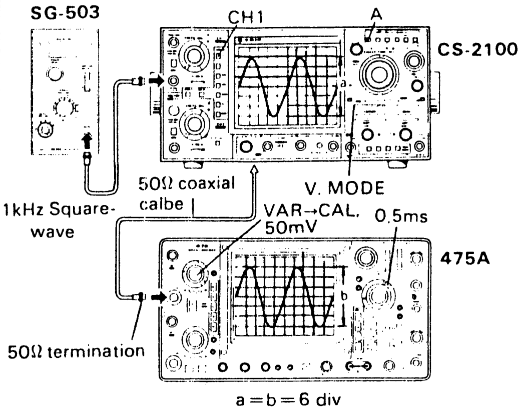
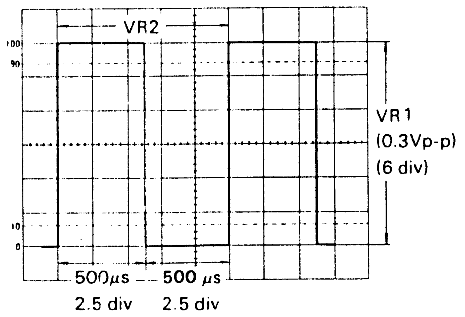
ADJUSTMENT

Item	Adjustment Control	P.C.B No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
ADJUSTMENT OF A, B TRIG AMPLIFIERS							
Adjustment of CH3 Gain and CH4 Gain	VR11 VR21	X73-1320 X73-1320	PG506	H.DISPLAY: A V.MODE: QUAD. ALT A TRIG SOURCE: 1/1 B TRIG SOURCE: 1/1 A SWEEP TIME/DIV: 0.2ms TRIG MODE: AUTO CH1, CH2 AC-GND-DC: GND	(1) Apply a 1 kHz squarewave signal simultaneously to CH3 and CH4 INPUT and adjust A TRIG LEVEL and B TRIG LEVEL to obtain synchronization. Operate CH3 and CH4 POSITION to bring the pattern to the center of the CRT screen. (2) Make adjustment so that the amplitude of CH3 and CH4 becomes 5 div., respectively. < Check > (1) Sensitivity error must be within ±3%. (See to Reference for the adjustment of CH1 Gain) (2) With A. TRIG SOURSE and B. TRIG SOURSE set to 1/10, make the 1 kHz squarewave signal 5 Vp-p and operate CH3 and CH4 POSITION to bring the waveform to the center of the CRT screen. The amplitude at this time must be within the range of 4.85～5.15 div. Sensitivity error | within ±3%.		< Note > If tilt or overshoot occurs to the 1 kHz waveform, refer to the section devoted to CH3 and CH4 waveform shaping.
CH3 Waveform Shaping	TC3 (A SOURCE 1/10) TC4(Medium range) TC3(Ultra high range)	X73-1130 X73-1320 X73-1320	PG-506	H.DISPLAY: A V. MODE: QUAD, ALT A TRIG SOURCE: 1/1 A SWEEP TIME/DIV: 0.2ms TRIG MODE: AUTO CH1, CH2 AC-GND-DC: GND	(1) Apply a 1 kHz square wave signal of fast rise time to CH3 INPUT and adjust the oscillator output to produce a waveform of 6 div on the CRT screen. (2) With A. SOURSE set to 1/10, produce a waveform of 6 div in the same manner and adjust TC3 to obtain the similar waveform as (1) above. (3) With A. SOURSE to 1/1 adjust the oscillator output and frequency to produce a square waveform of 1 MHz 6 div on the CRT screen and shape the waveform in the medium and ultra-high ranges. < Check > Overshoot | less than 8%.		< Note > When shapping the waveform, terminate the input terminal of oscilloscope to match the output impedance of the oscillator
CH4 Wave form Shapping	TC6 (B SOURCE 1/10) TC8(Medium range) TC7(Ultra high range)	X73-1130 X73-1320 X73-1320	PG-506	H.DISPLAY: DUAL V.MODE: QUAD.ALT A TRIG SOURCE: 1/1 B TRIG SOURCE: 1/1 A SWEEP TIME/DIV: 0.2ms B SWEEP TIME/DIV: 0.2ms	(1) Apply a 1kHz and 1 MHz square wave signals of fast rise time to CH4 INPUT and take the same steps as in (1) above to shape the waveform. < Check > Overshoot | less than 8%.		
Adjustment of CH3 Input Capacity	TC1(1/1) TC2(1/10)	X77-1130 X77-1130	4343B	A TRIG SOURCE: 1/1 B TRIG SOURCE: 1/1	(1) Measure the input capacity of CH3 and make adjustment so that it becomes equal to the value of CH1 5mV range (28 ± 3PF). (2) Adjust the input capacity to become equal to that at 1/1. < Check > The difference between A SOURCE 1/1 and A SOURCE 1/10 less than 1pF. It shall be the same with B SOURCE.		
Adjustment of CH4 Input Capacity	TC4 (1/1) TC2 (1/10)	X77-1130 X77-1130			Adjust the input capacity in the same manner as CH3. < Check > Check the input capacity in the same manner as CH3. Overshoot | less than 8%.		

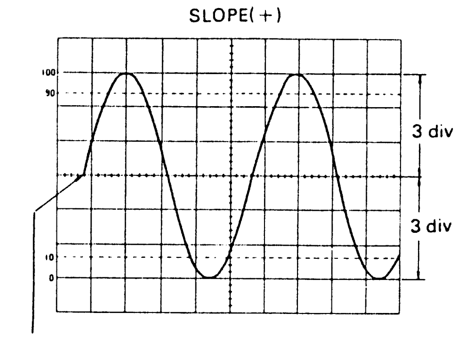
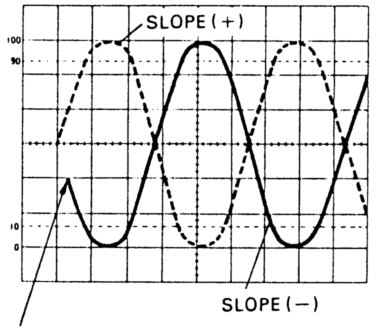
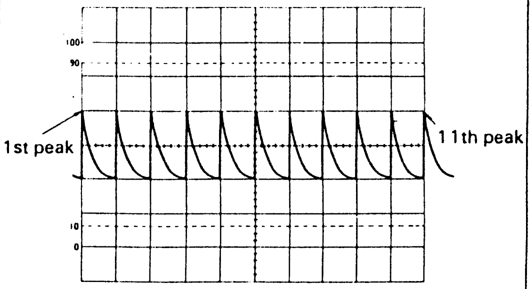
ADJUSTMENT

Item	Adjustment Control	P.C.B No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
ADJUSTMENT OF VERTICAL AXIS (II)							
Check of 1 MHz Square wave Characteristics Square wave Characteristics of CH1 and CH2			PG-506	H.DISPLAY: A A. TRIG SOURCE: V.MODE A.SWEEP TIME/DIV: 0.2μs~ 0.02μs TRIG.MODE: AUTO A COUPLING: AC	(1) Check the squarewave characteristics of CH1 and CH2 5mV range. Turn the VOLTS/DIV knob for each channel to adjust the oscillator output so that CH1 and CH2 will produce a waveform of 6 div, respectively. (2) The overshoot must be less than 8% for each range.		<Note> As the VOLTS/DIV is manually rotated, the amplitude of 6 divs cannot be obtained amplitude.
Square wave Characteristics of CH3 and CH4				H. DISPLAY: DUAL V. MODE: QUAD. ALT A.TRIG SOURCE: 1/1 B.TRIG SOURCE: 1/1	(1) Apply a 1 MHz squarewave signal to CH3 and CH4 INPUT and see if the overshoot is less than 8% at this time. (2) The overshoot must be less than 8% when A TRIG SOURCE is turned from 1/1 to 1/10 and B TRIG SOURCE from 1/1 to 1/10.		
CHeck of CH1 and CH2 Frequency Characteristics			SG-503 50Ω coaxial cable (BNC-BNC) 50Ω 20dB attenuator	H. DISPLAY: A TRIG MODE: AUTO A. TRIG SOURCE: V. MODE A COUPLING: AC CH1, CH2 AC-GND-DC: DC A SWEEP TIME/DIV: 2μs~ 0.02μs	(1) With CH1 VOLTS/DIV set to 5 mV, apply a sine wave signal of 50kHz to INPUT and adjust the oscillator output to produce a waveform of 6 div on the CRT screen. (2) When the frequency is varied to 100 MHz with the oscillator output remaining unchanged, the amplitude on the screen must be over 4.25 div and there must be no sudden dips and peaks during attenuation. (3) Perform the same operations for CH2. Frequency characteristic 100MHz: less than −3 dB (4) When the specification are not satisfied, readjust the 1 MHz squarewave characteristics.		
Check of CH3 and CH4 Frequency Characteristics				H. DISPLAY: DUAL V.MODE: QUAD.ALT TRIG. MODE: AUTO A TRIG SOURCE: 1/1 B. TRIG SOURCE: 1/1	(1) Apply a sine wave signal of 50 kHz to CH3 INPUT and adjust the oscillator output to produce a waveform of 6 div on the CRT screen. (2) When the frequency is changed to 100MHz with the oscillator output remaining unchanged, the amplitude on the screen must be over 4.25 div. (3) With A. TRIG SOURCE, measure the amplitudes at 100MHz to see if they are within the specification limits. Frequency characteristic 100MHz : less than −3 dB (4) Perform the same operations for CH4. (5) When the specification are not satisfied, readjust the 1 MHz squarewave characteristics.		
Check of CH1 and CH2 X5 GAIN Frequency Characteristics			SG-503	H.DISPLAY: A A TRIG SOURCE: V. MODE TRIG.MODE: AUTO CH1, CH2 AC-GND-DC: DC CH1, CH2 VOLTS/DIV: 5mV CH1, CH2 X5 GAIN: PULL	(1) With V. MODE set to CH1, apply a sine wave signal of 50 kHz to CH1 INPUT and adjust the oscillator output to produce a waveform of 6 div on the CRT screen. (2) When the frequency is varied to 100MHz with the oscillator output remaining unchanged, the amplitude on the screen must be over 4.25 div. (3) Set V. MODE to CH2 and make a similar check. X5 GAIN frequency characteristic 100 MHz: less than −3 dB.		

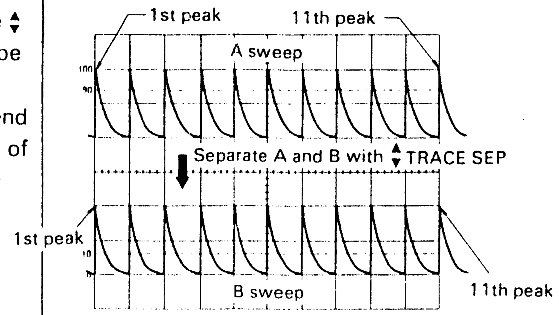
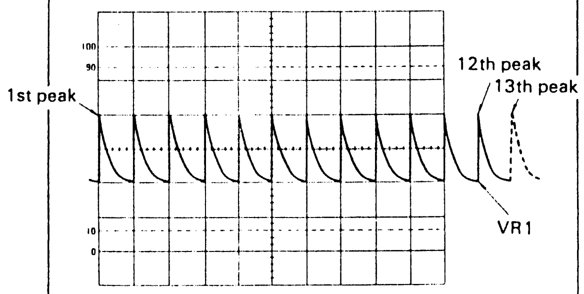
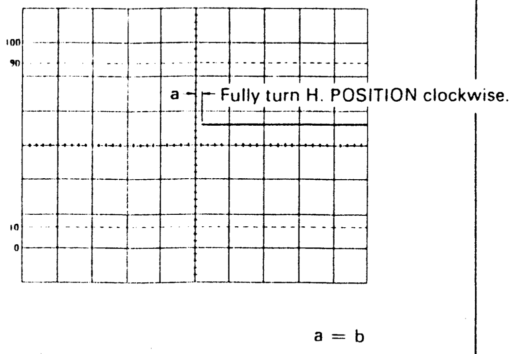
ADJUSTMENT

Item	Adjustment Control	P.C.B No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
Check of 20MHz BW Frequency Characteristics			SG-503	H.DISPLAY: A V.MODE: CH1 A TRIG SOURCE: V.MODE CH1 AC-GND-DC: DC CH1 VOLTS/DIV: 5mV 20MHz BW: ON TRIG MODE: AUTO	(1) Apply a sine wave signal of 50kHz to CH1 INPUT to produce a waveform of 6 div. (2) Vary the frequency of the input signal without changing the oscillator output and read the frequency at which the amplitude on the screen becomes 4.25 div. This frequency must be within the specification limits. 20MHz BW Frequency characteristics Frequency of −3 dB:16 MHz−24 MHz.		
Check of CH1 OUT Frequency Characteristics			475A 50Ω Termination (through type) 50Ω coaxial cord (BNC-BNC) SG-503	CH1 AC-GND-DC: AC CH1 VOLTS/DIV: 5mV CH1 ⇕ POSITION: 12 o'clock	(1) With the vertical axis sensitivity of 475A set to 50mV, lead a 50Ω coaxial cable from CH1 OUT and terminate it with 50Ω termination and connect it to CH1 OUT of 475A. (2) Apply a sine wave signal of 50kHz to CH1 INPUT and adjust the oscillator output so that the vertical amplitude of 475A becomes 6 div. When the frequency is varied to 100MHz without changing the oscillator output, the amplitude on the CRT screen of 475A must be over 4.25 div. CH1 OUT frequency characteristic 100 MHz: less than −3 dB	 SG-503 CH1 A CS-2100 a 50Ω coaxial calbe V. MODE 1kHz Square-wave VAR→CAL, 50mV 0.5ms 475A b 50Ω termination a=b=6 div	< **Note** > If the squarewave characteristics of CH1 PREAMP and V OUTPUT AMP are readjusted the squarewave characteristic and frequency characteristic will also change.
Adjustment of CAL Output	VR1 VR2	X77-1130 X77-1130	475A FC-754A DL-720		(1) Short-circuit TP2 (X77−1130) and adjust VR1 so that the voltage at CAL output terminal becomes 0.3 ±1%. (2) Set the vertical axis sensitivity of 475A to 5mV and the sweep time to 0.2 ms. (3) Lead a probe from the calibration voltage output terminal (CAL) of CS-2100 and connect it to CH1 INPUT of 475A. (4) Adjust VR2 so that the frequency becomes 1 kHz. < **Check** > Check the duty ratio. Frequency: Within 1 kHz ±3%. Output voltage: Within 0.3 Vp-p ±1%. Dudy ratio: Within (50 ±2)%	 VR2 100 90 10 0 VR1 (0.3Vp-p) (6 div) 500μs 500 μs 2.5 div 2.5 div	< **Note** > For checking the frequency, a frequency counter (FC-754A) may be used.
ADJUSTMENT OF HORIZONTAL SWEEP							
Adjustment of Sweep Rotary unit	VR1	X74-1250		H. DISPLAY: A V.MODE: CH1 TRIG MODE: AUTO CH1, CH2 AC-GND-DC: GND	(1) Operate◂▸POSITION and CH1 ⇕ POSITION to bring the trace to the center of the CRT screen. (2) Adjust VR1 so that the voltage at IC11, 8 pin (X74-1220) becomes 29V ±1%.		

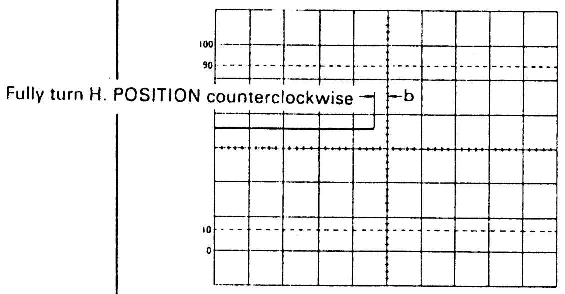
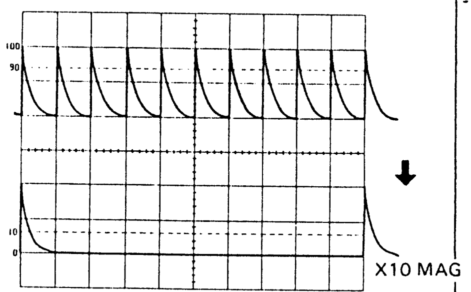
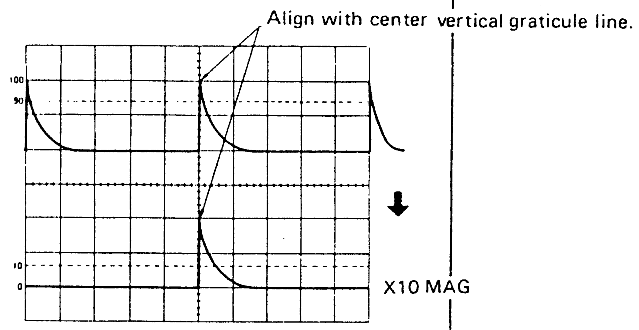
ADJUSTMENT

Item	Adjustment Control	P.C.B No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
Coarse Adjustment of A and B Trigger Center and SLOPE **(Coarse Adjustment of A Trigger Center and SLOPE)**	VR2 VR3	X77-1110 X77-1110	SG-502	H.DISPLAY: A V.MODE: CH1 TRIG MODE: AUTO CH1 AC-GND-DC: AC A SWEEP TIME/DIV: 0.2ms A TRIG SOURCE: V. MODE A COUPLING: AC TRIG LEVEL: 12 o'clock TRIG SLOPE: +	(1) Apply a sine wave signal of 1 kHz to CH1 INPUT and adjust the oscilloscope output and ⬍ position to produce a waveform of amplitude 3 div above and below the horizontal center graticule line on the CRT screen. (2) Adjust VR2 so that the starting point of the waveform is aligned with the horizontal center graticule line on the CRT screen. (3) Set TRIG. SLOPE to (−) and adjust VR3 to bring the starting point to the position of the starting point of the waveform produced when TRIG. SLOPE is set to (+).	 Align the starting point with the horizontal center graticule line  Align SLOPE (−) with the starting point of SLOPE (+)	
(Coarse Adjustment of B Trigger Center and SLOPE)	VR2 VR3	X77-1120 X77-1120	SG-502	H.DISPLAY: DUAL V.MODE: CH1 A TRIG SOURCE: V. MODE B TRIG SOURCE: CH1 B COUPLING: AC B TRIG LEVEL: 12 o'clock B TRIG SLOPE: + A SWEEP TIME/DIV: 0.5ms B SWEEP TIME/DIV: 0.2ms TRIG. MODE: AUTO ⬍ TRACE SEP: NORM	(1) Set A. INTEN to Fully CCW. (2) Apply a sine wave signal of 1 kHz to CH1 INPUT and adjust the oscillator output and ⬍ position to produce a waveform of amplitude 3 div above and below the horizontal center graticule line on the CRT screen. (3) Next, set TRIG. SLOPE to (−) and make adjustment to bring the starting point of the waveform to the position of the starting point of the waveform produce when TRIG. SLOPE is set to (+).		
Adjustment of A Sweep Time	VR9	X74-1220	TG-501	H.DISPLAY: A V.MODE: CH1 A TRIG SOURCE: V. MODE A SWEEP TIME/DIV: 0.1ms TRIG MODE: AUTO A. VAR: CAL	(1) Apply a marker signal of 0.1 ms to CH1 INPUT. (2) Operate ◂▸ POSITION to bring the first peak of the marker signal to the left end of the graticule line and adjust VR9 for the 11th peak to the right end of the graticule line.		**<Note>** When TG-501 is used, set CH1 AC-GND-DC to AC, VOLTS/DIV to 0.5V/div, depress PUSH 50Ω to obtain an input impedance of 50Ω.

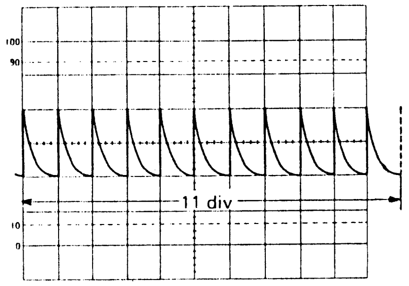
ADJUSTMENT

Item	Adjustment Control	P.C.B No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
Adjustment of B Sweep Time	VR7	X74-1220	TG-501	H.DISPLAY: DUAL V.MODE: CH1 A. TRIG SOURCE: V. MODE B. TRIG SOURCE: CH1 A SWEEP TIME/DIV: 0.1ms B SWEEP TIME/DIV: 0.1ms TRIG.MODE: AUTO A,B TRIG.SLOPE: + A,B INTEN: Fully CW	(1) Apply a marker signal of 0.1 ms to CH1 INPUT. (2) On the screen A and B sweeps of CH1 input signal will appear. Operate ↕ TRACE SEP to bring these sweeps into the positions where they can be easily adjusted. (3) Make adjustment so that the first peak of B sweep is brought to the left end of the graticule line on the screen and the 11th peak to the right end of graticule line on the screen. (4) Make sure that A and B TRIG'D lamps are on.	 1st peak 11th peak A sweep 100 90 Separate A and B with ↕ TRACE SEP 1st peak 10 0 B sweep 11th peak	< **Note** > 1. When TG-501 is used, the knobs must be operated in the same manner as described above. 2. If the 11th peak is not visible, adjust VR5 (X74-1220) Sweep Length 3. The B sweep time will not change even if A VAR is turned.
Adjustment of A Sweep Length	VR1	X74-1220		H. DISPLAY: A V. MODE: CH1 A TRIG SOURCE: V. MODE A SWEEP TIME/DIV: 0.1ms TRIG MODE: AUTO	(1) Apply a marker signal of 0.1 ms to CH1 INPUT. (2) Make adjustment so that the total length is 11 div.	 100 90 1st peak 12th peak 13th peak VR1 10 0	< **Note** > Turn ↔ POSITION to shift the base line two markers to the left then you can see the 12th time marker with the graticule area.
Adjustment of B Sweep Length	VR5	X74-1220		H. DISPLAY: DUAL V. MODE: CH1 A TRIG SOURCE: V. MODE B TRIG SOURCE: CH1 A SWEEP TIME/DIV: 0.1ms B SWEEP TIME/DIV: 0.1ms TRIG MODE: AUTO A, B TRIG SLOPE: + A, B INTEN: Fully CW	(1) Apply a marker signal of 0.1 ms to CH1 INPUT. (2) A and B sweeps will appear on the screen. Use ↕ TRACE SEP to separate them. (3) Make adjustment so that the total length of B sweep is 11 div.		
Adjustment of A Sweep Position	VR10	X74-1220		H.DISPLAY: A V. MODE: CH1 A TRIG SOURCE: V. MODE A SWEEP TIME/DIV: 0.1ms TRIG MODE: AUTO	(1) Set CH1 AC-GND-DC to GND to bring the trace to the center of the CRT screen. (2) Set the FINE knob of ↔ POSITION to 12 o'clock. (3) Turn ↕ POSITION fully CW without turning the FINE knob and note the deviation between the starting point of the trace and the center of the screen. Next, turn ↔ POSITION fully CCW and measure the distance between the ending point of the trace and the center of the screen. Make adjustment so that these deviations will have the same width. Width error | less than 1 div.	 100 90 a Fully turn H. POSITION clockwise. 10 0 a = b	

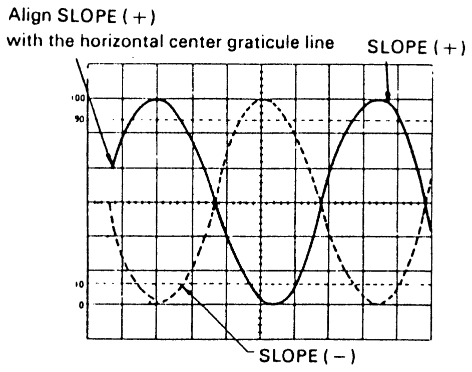
ADJUSTMENT

Item	Adjustment Control	P.C.B No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
						 100 90 Fully turn H. POSITION counterclockwise b 10 0	
Adjustment of B Sweep Position	VR8	X74-1220	TG-501	H.DISPLAY: DUAL V.MODE: CH1 A TRIG SOURCE: V. MODE B TRIG SOURCE: CH1 A,B SWEEP TIME/DIV: 0.1ms TRIG MODE: AUTO A, B TRIG SLOPE: + A, B INTEN: Fully CW	(1) Apply a marker signal of 0.1 ms to CH1 INPUT and align the first peak of A sweep to the leftmost division of the CRT screen. (2) Operate ⬍ TRACE SEP to separate A sweep and B sweep and set A. VAR to CAL. (3) Make adjustment so that the starting point of B sweep is aligned with that of A sweep in the horizontal position. **< Check >** Operate ⬍ TRACE SEP so that A sweep and B sweep are superimposed on one another and make sure that their starting points coincide with each other.		
Adjustment of X10 MAG Gain	VR12	X74-1220	TG-501	H.DISPLAY: A V.MODE: CH1 A TRIG SOURCE: V.MODE A SWEEP TIME/DIV: 0.1ms TRIG MODE: AUTO CH1, VOLTS/DIV: 1V CH1, AC-GND-DC: DC PUSH 50Ω: PUSH	(1) Apply a marker signal of 0.1 ms to CH1 INPUT to produce a waveform of vertical amplitude of about 2 div. (2) Align the first peak of the marker signal with the left end of the graticule line on the CRT screen and the 11th peak with the right end and pull the X10 MAG switch. (3) Make adjustment so that the peak-to-peak distance is 10 div. **< Check >** Specification | 10 times ±5%		
Adjustment of X10 MAG Center	VR13	X74-1220		H. DISPLAY: A V. MODE: CH1 A TRIG SOURCE: V. MODE A SWEEP TIME/DIV: 0.1ms A. VAR: CAL TRIG. MODE: AUTO A, TRIG SLOPE: +	(1) Apply a marker signal of 0.5 ms to CH1 INPUT to produce 3 peaks waveform on the CRT screen. (2) Operate ◄ ► POSITION to bring the central peak to the vertical center graticule line on the screen. (3) Make adjustment so that the waveform will be aligned with the vertical center graticule line on the screen when the FINE knob is pulled out (X10 MAG position). **< Check >** Repeatedly push and pull the FINE knob to make sure that the center of the waveform does not move. Deviation | less than 1 div.	 Align with center vertical graticule line. 100 90 10 0 X10 MAG	
Adjustment of MAG Center and Gain					Recheck the center at × 10 MAG and Gain.		

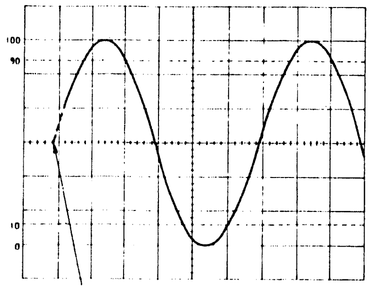
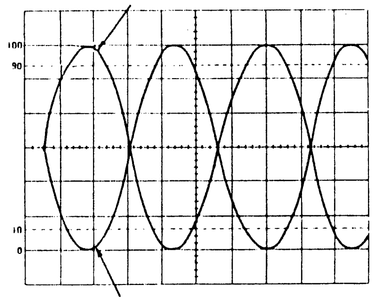
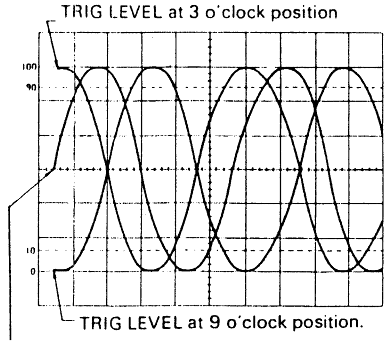
ADJUSTMENT

Item	Adjustment Control	P.C.B No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
Adjustment of A Sweep Time 1μs and 0.02μs	TC1 TC9	X74-1220 X74-1220	TG-501	H. DISPLAY: A V. MODE: CH1 A. TRIG SOURCE: V. MODE TRIG. MODE: AUTO A VAR: CAL	(1) With A. SWEEP TIME/DIV set to 1 μs, apply a marker signal of 1 μs to CH1 INPUT. (2) Adjust TC1 so that the first peak of the marker signal is aligned with the left end of the graticule on the screen and the 11th peak with the right end. (3) Next, Rotate the A SWEEP TIME/DIV to 0.02μs and apply a 0.02μs time marker to CH1 INPUT and adjust TC9 in the same manner as (2)		
Adjustment of B Sweep Time 1 μs and 0.02μs	TC4 TC10	X74-1220 X74-1220		H.DISPLAY: DUAL V.MODE: CH1 A TRIG SOURCE: V. MODE B TRIG SOURCE: CH1 A, B TRIG MODE: AUTO A, B TRIG SLOPE: + A, B INTEN: Fully CW	(1) Set A and B SWEEP TIME/DIV to 1 μs and apply a marker signal of 1 μs to CH1. (2) Operate ↕ TRACE SEP to separate A sweep and B sweep to be in the positions where adjustment can be made easily. (3) Adjust TC4 so that the first peak of the marker signal is aligned with the left end of the graticule line on the screen and the 11th peak with the right end. (4) Rotate A.B. SWEEP TIME/DIV to 0.02 μs and apply a 0.02μs time marker to CH1 INPUT and adjust TC10 in the same manner as (3)		
Adjustment of 0.02μs A Sweep Length	TC2	X74-1220		H.DISPLAY: A V.MODE: CH1 A TRIG SOURCE: V MODE A SWEEP TIME/DIV: 0.02μs A. VAR: CAL TRIG. MODE: AUTO A. TRIG SLOPE: +	(1) Apply a marker signal to CH1 INPUT. (2) Make adjustment so that the total length of the waveform is 11 div.		
Adjustment of 0.02μs B Sweep Length	TC5	X74-1220		H.DISPLAY: DUAL V.MODE: CH1 A TRIG SOURCE: V. MODE B TRIG SOURCE: CH1 TRIG MODE: AUTO A, B TRIG SLOPE: + A,B INTEN: Fully CW	(1) With A and B SWEEP TIME/DIV to 0.02 μs, apply a marker signal of 0.02 μs to CH1 INPUT. (2) Operate ↕ TRACE SEP to separate A sweep and B sweep into the positions where they can be easily adjusted. (3) Make adjustment so that the total length of the waveform is 11 div.		
Check of Sweep Time Error in All the Range [I]				H.DISPLAY: A V. MODE: CH1 A TRIG SOURCE: V. MODE TRIG. MODE: AUTO A VAR: CAL	(1) Apply a reference time marker signal for each range of A SWEEP TIME/DIV. (2) Measure the time error rate and make sure it is within the specification limits. Specification Within ±3%.		
[II]				H. DISPLAY: DUAL V. MODE: CH1 A TRIG SOURCE: V. MODE B TRIG SOURCE: CH1 A. VAR: CAL TRIG. MODE: AUTO A, B TRIG SLOPE: + A, B INTEN: Fully CW	(1) Operate ↕ TRACE SEP to separate A sweep and B sweep into the positions where they can be easily adjusted. (2) Apply a reference time marker signal in each of all the ranges (50 ms−0.02 μs) of B sweep. (3) Measure the time error rate and make sure it is within the specification limits. Specification Within ±3%.		

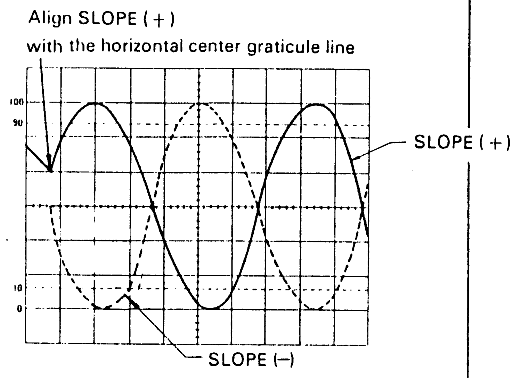
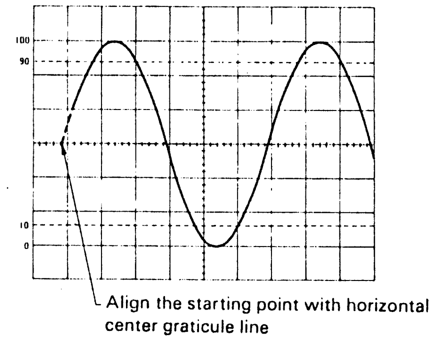
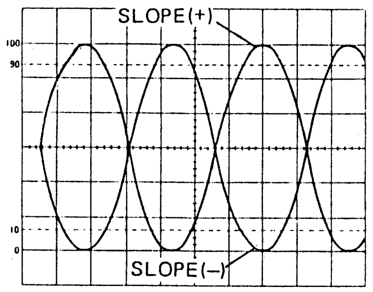
ADJUSTMENT

Item	Adjustment Control	P.C.B No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
ADJUSTMENT OF X — Y OPERATION							
Adjustment of X Position Center	VR11	X74-1220		H.DISPLAY: A V. MODE: DUAL, ALT CH1,CH2 VOLTS/DIV: 5mV CH1, CH2 AC-GND-DC: DC A TRIG SOURCE: CH1 TRIG. MODE: AUTO A SWEEP TIME/DIV: 0.1ms	(1) Operate ↕ POSITION for both CH1 and CH2 to superimpose the two traces on one another in the center of the CRT screen. (2) Make adjustment so that the bright spot comes to the center of the screen when H. DISPLAY is switched in X-Y. < **Check** > Operate CH2 ↕ POSITION and make sure that the spot will move as described below. (1) When the knob is turned counterclockwise, the spot moves leftward more than 5 div. (2) When the knob is turned clockwise, the spot moves rightward more than 5 div. Distance between the spot and the center of screen within ±1 div from the center of the screen.		< **Note** > When making X-Y adjustment, do not set both CH1 and CH2 to X5. GAIN.
Adjustment of X Gain	VR18	X73-1320	PG-506	H.DISPLAY: X-Y CH2 AC-GND-DC: AC CH2 VOLTS/DIV: 5mV	(1) Apply a square wave signal of 20 mVp-p 1 kHz to CH2 INPUT and make adjustment so that the horizontal amplitude is 4 div.		
Readjustment of X Position Center and X Gain					Readjust X position Center and X Gain.		
Check of X Axis Frequency Characteristic			SG-502	H. DISPLAY: X-Y CH2 AC-GND-DC: DC CH2 VOLTS/DIV: 5mV	(1) Apply a sine wave signal of 1 kHz to CH2 INPUT and adjust the oscillator output to produce a waveform of 10 div. (2) When the frequency is varied to 5 MHz without changing the oscillator output, the amplitude must be over 7.1 div (−3 dB). Frequency characteristic DC −5 MHz: less than −3 dB.		
ADJUSTMENT OF TRIGGERING							
Adjustment of A Trig Slope	VR3	X77-1110	SG-502	H.DISPLAY: A V.MODE: CH1 A TRIG SOURCE: V. MODE A COUPLING: AC CH1, CH2 AC-GND-DC: AC CH1, CH2 VOLTS/DIV: 5mV A SWEEP TIME/DIV: 0.2ms A TRIG SLOPE: + TRIG MODE: AUTO	(1) Apply a sine wave signal of 1 kHz to CH1 INPUT and adjust the oscillator output to produce a waveform of 4∼6 div on the CRT screen. (2) Operate A TRIG LEVEL and CH1 ↕ POSITION so that the waveform may have an amplitude equally above and below the horizontal center graticule line on the CRT screen. (3) Set A TRIG SLOPE to (−) and make adjustment so that the starting point of the waveform will be in the position of the starting point of the waveform when A TRIG SLOPE is in the (+) position. < **Check** > (1) Repeatedly turn the A TRIG SLOPE knob from (+) to (−) and make sure that the starting points are in the same positions. (2) Make sure that the rise slope of the waveform will be synchronized when the A TRIG SLOPE knob is in the (+) position and the fall slope will be synchronized when the knob is in the (−) position. (3) Feed the same signal to CH2 and set V MODE to CH2 to produce a waveform of CH2 and make sure that the rise slope of the waveform is synchronized when the A TRIG SLOPE knob is at (+) and the fall slope is synchronized when it is at (−) position.	 Align SLOPE (+) with the horizontal center graticule line SLOPE (+) 100 90 10 0 SLOPE (−)	

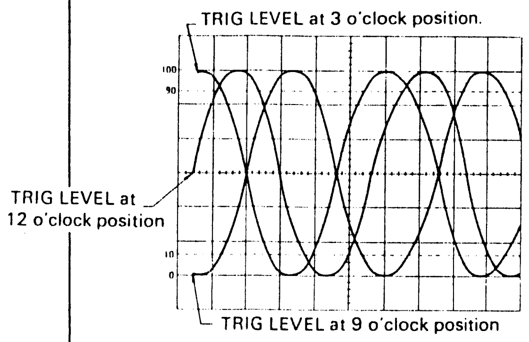
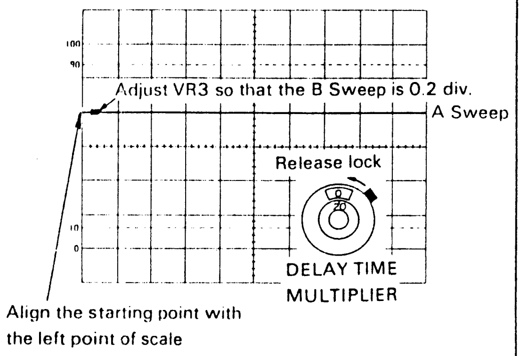
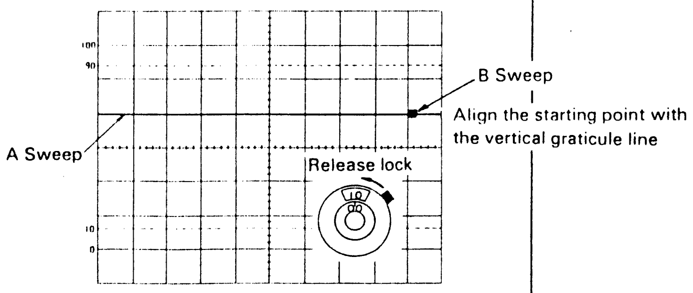
ADJUSTMENT

Item	Adjustment Control	P.C.B No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
Adjustment A Trig Level Center	VR2	X77-1110	SG-502	H.DISPLAY: A V.MODE: CH1 A TRIG SOURCE: V. MODE A. COUPLING: AC CH1, CH2 AC-GND-DC: AC CH1, CH2 VOLTS/DIV: 5mV A SWEEP TIME/DIV: 0.2ms A TRIG SLOPE: + TRIG MODE: AUTO	(1) Set A TRIG LEVEL to 12 o'clock. (2) Apply a sine wave signal of 1 kHz to CH1 INPUT and adjust the oscillator output to produce a waveform of 4∼6 div on the CRT screen. (3) Operate CH1 ⇕ POSITION to move the waveform so that its amplitude is equally above and below the horizontal center graticule line on the CRT screen. (4) Make adjustment so that the starting point of the waveform is on the horizontal center graticule line on the CRT screen. < Check > (1) When A TRIG SLOPE is alternately turned to (+) and (−), the starting point must be always on the horizontal center graticule line. (2) With A TRIG SLOPE remaining in the position of (+), turn TRIG LEVEL clockwise toward 3 o'clock from near 9 o'clock and see if the waveform is as shown at right. (3) Adjust the oscillator output so that the waveform amplitude becomes 0.5 div and make sure that synchronization can be obtained by A TRIG LEVEL.	 Align the starting point with the horizontal center graticule line SLOPE (+)  SLOPE (−) TRIG LEVEL at 3 o'clock position  TRIG LEVEL at 9 o'clock position. TRIG LEVEL at 12 o'clock position	

ADJUSTMENT

Item	Adjustment Control	P.C.B No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
Adjustment of B Trig Slope	VR3	X77-1120	SG-502	H.DISPLAY: DUAL V.MODE: CH1 A TRIG SOURCE: V. MODE B TRIG SOURCE: CH1 A,B COUPLING: AC CH1, CH2 AC-GND-DC: AC CH1, CH2 VOLTS/DIV: 5mV A, B SWEEP TIME/DIV: 0.2ms A. VAR: CAL A, B TRIG.SLOPE: + TRIG MODE: AUTO A, B INTEN: Fully CW	(1) Apply a sine wave signal of 1 kHz to CH1 INPUT and adjust the oscillator output to produce a waveform of 4~6 div on the CRT screen. (2) Operate A TRIG LEVEL, B TRIG LEVEL and CH1 ⬍ POSITION to move waveform so that its amplitude is equally above and below the horizontal center graticule line on the screen. (3) Set A INTEN to CCW and B INTEN to an arbitrary position near 3 o'clock. (4) Set B TRIG SLOPE to (−) and make adjustment so that the starting point of the waveform comes to the same position of the starting point of waveform when B TRIG SLOPE is in the (−) position. < Check > (1) Turn B TRIG SLOPE knob alternately to (+) and (−) and make sure that the starting point is always on the horizontal center graticule line. (2) When B TRIG SLOPE is in the (+) position, the rise slope of the waveform should be synchronized and its fall slope be synchronized at (−). (3) Apply the same signal to CH2 and set V. MODE to CH2 to produce a waveform of B sweep of CH2 on the screen to make sure that the rise slope of the waveform is synchronized when B TRIG SLOPE is at (+) and the fall slope is synchronized at (−).	 Align SLOPE (+) with the horizontal center graticule line 	
Adjustment of B Trig Level Center	VR2	X77-1120	SG-502	H.DISPLAY: DUAL V. MODE: CH1 A, B COUPLING: AC CH1, CH2 AC-GND-DC: AC CH1, CH2 VOLTS/DIV: 5mV A, B SWEEP TIME/DIV: 0.2ms A. VAR: CAL B. TRIG SOURCE: CH1	(1) Turn B TRIG LEVEL knob to 12 o'clock. (2) Apply a sine wave signal of 1 kHz to CH1 INPUT and adjust the oscillator output to produce a waveform of 4~6 div on the CRT screen. (3) Operate CH1 ⬍ POSITION so that the waveform has an amplitude equally above and below the horizontal center graticule line on the screen. (4) Turn A INTEN to CCW and B INTEN to a position near 3 o'clock and make adjustment so that the starting point of the waveform is on the horizontal center graticule line. < Check > (1) Turn B TRIG SLOPE alternately to (+) and (−) and make sure that the starting point of the waveform is always on the horizontal center graticule line. (2) With B TRIG SLOPE knob remaining in the (+) position, turn TRIG LEVEL knob clockwise toward 3 o'clock from near 9 o'clock and see if the waveform appear as shown at right. (3) Adjust the oscillator output so that the waveform amplitude becomes 0.5 div and make sure that synchronization is obtained at this time by operating B TRIG LEVEL.	 Align the starting point with horizontal center graticule line  	

ADJUSTMENT

Item	Adjustment Control	P.C.B No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
						 TRIG LEVEL at 3 o'clock position. 100 90 TRIG LEVEL at 12 o'clock position 10 0 TRIG LEVEL at 9 o'clock position	
Adjustment of DELAY TIME MULTIPLIER	VR3	X74-1220		H. DISPLAY: ALT V. MODE: CH1 CH1 AC-GND-DC: GND TRIG MODE: AUTO A SWEEP TIME/DIV: 0.1ms B SWEEP TIME/DIV: 10μs ⇕ TRACE SEP: NORM STARTS AFTER DELAY: PULL	(1) Set DELAY TIME MULTIPLIER to 0.20. (2) Operate A INTEN and B INTEN properly to make B trace brighter and A trace light dimmer. (3) Operate ◂▸POSITION to bring the starting point of A trace to the left end of the graticule line on the CRT screen. (4) Make adjustment so that B trace may appear as shown at right. (5) Next, set DELAY TIME MULTIPLIER to 9.00. Make adjustment so that B trace may appear as shown at right. (6) Repeat (1) thru (5) 2 or 3 times.	 100 90 Adjust VR3 so that the B Sweep is 0.2 div. A Sweep Release lock 10 0 DELAY TIME MULTIPLIER Align the starting point with the left point of scale	
	VR2	X74-1220			< Check > Set DELAY TIME MULTIPLIER to 5.00 and make sure that the starting point of B trace is in a position within 5 div ±0.2 div from the left end of the screen.	 100 90 B Sweep Align the starting point with the vertical graticule line A Sweep Release lock 10 0	

ADJUSTMENT

Item	Adjustment Control	P.C.B No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark
OPERATING CHECKS							
Check of Current CAL			Current probe P6302 AM503 475A		(1) Touch a current proble to current CAL terminal on the rear side to make sure that the calibration current is 1 kHz ±3% and 10 mA ±2%.		
Check of Triggering Sensitivity			SG-502 SG-503 475A	V.MODE: CH1 CH1 VOLTS/DIV: 5mV A,B SWEEP TIME/DIV: arbitrary position CH1 AC-GND-DC: AC TRIG MODE: NORM	(1) Make measurements of triggering sensitivity according to the table given below. (For both A and B sweeps) **[I] A Sweep, INT** (1) Set H DISPLAY to A and A TRIG SOURCE to CH1. (2) Apply a sine wave signal to CH1 INPUT, vary the oscillator output and operate A TRIG LEVEL to measure the minimum synchronizing amplitude on the CRT screen. When doing this, make sure that the A TRIG' D lamp is on. Check synchronization by each check frequency. **[II] B Sweep, INT** (1) Set H DISPLAY to B DLY'D, A TRIG SOURCE to CH1 and B TRIG SOURCE to CH1. (2) Apply a sine wave to CH1 INPUT, vary the oscillator output and operate B TRIG LEVEL to measure the minimum synchronizing amplitude. When doing this, make sure that the A TRIG'D and B TRIG'D lamps are on. Check synchronization by each frequency. **[III] A Sweep, Ext** (1) Set H DISPLAY to A and A TRIG SOURCE to EXT 1/1 or 1/10. (2) Apply a signal of the same voltage simultaneously to CH1 and CH4 INPUT. (3) Operate CH1 VOLTS/DIV to produce a waveform of 6 div on the CRT screen. (4) Vary the oscillator output and operate A TRIG LEVEL to measure the minimum synchronizing amplitude by the oscilloscope (475A). Check synchronization by each check frequency. When doing this, make sure that A TRIG'D lamp is on. **[IV] B Sweep, EXT** (1) Set H DISPLAY to ALT, A TRIG SOURCE to CH1 and B TRIG SOURCE to EXT 1/1 or 1/10. (2) Apply a signal of the same voltage simultaneously to CH1 and CH4 INPUT. (3) Operate CH1 VOLTS/DIV to produce a waveform of 6 div on the CRT screen. (4) Operate B TRIG LEVEL and A TRIG LEVEL to synchronize both A sweep and B sweep. (5) Vary the oscillator output and operate B TRIG LEVEL and measure the minimum synchronizing amplitude by the oscilloscope (475A). Check synchronization by each check frequency. (6) Make sure that the B TRIG'D lamp is on.		

ADJUSTMENT

Item	Adjustment Control	P.C.B No.	Test Equipment	Control Setting	Adjustment and Check	Illustration	Remark

[V] Check of triggering sensitivity

COUPLING (TRIG. SOURCE)	FREQ RANGE (Hz)	Trig. sensitivity (Min. sync amplitude)		
		TRIG. SOURCE V.MODE (CH1 or CH2)	TRIG SOURCE EXT 1/1	TRIG SOURCE EXT 1/10
AC	20Hz ~ 20MHz	0.5div	50mVP-p	0.5Vp-p
	~ 50MHz	1 div	100mVp-p	1 Vp-p
	~ 100MHz	1.5div	150mVp-p	1.5Vp-p
DC	DC ~ 20MHz	0.5div	50mVp-p	0.5Vp-p
	~ 50MHz	1 div	100mVp-p	1 Vp-p
	~ 100MHz	1.5div	150mVp-p	1.5Vp-p
AC HF_{REJ}	1kHz	0.5div	50mVp-p	0.5Vp-p
	1MHz	Not to be synchronized at 1 div	Not to be synchronized at 100mVp-p	Not to be synchronized at 1Vp-p
AC LF_{REJ}	1MHz	0.5div	50mVp-p	0.5Vp-p
	1kHz	Not to be synchronized at 1 div	Not to be synchronized at 100mVp-p	Not to be synchronized at 1Vp-p
VIDEO	FRAME signal VIDEO LINE	0.5div	50mVp-p	0.5Vp-p

[VI] Check of triggering sensitivity by TRIG. MODE

H. DISPLAY : A, A SOURCE : AC

COUPLING (TRIG. SOURCE)	FREQ RANGE (Hz)	Trig. sensitivity (Min. sync. amplitude)		
		TRIG SOURCE V.MODE (CH1 or CH2)	TRIG. SOURCE EXT 1/1	TRIG. SOURCE EXT 1/10
AUTO	30Hz ~ 20MHz	0.5div	50mVp-p	0.5Vp-p
	~ 50MHz	1 div	100mVp-p	1 Vp-p
	~ 100MHz	1.5div	150mVp-p	1.5Vp-p
FIX	40Hz ~ 20MHz	0.5div	50mVp-p	0.5Vp-p
	~ 80MHz	1.5div	150mVp-p	1.5Vp-p

[VII] Check of trig source (A sweep)

① TRIG MODE: AUTO, H.DISPLAY: A

② Applied different signals to CH1 ~ CH4 and operate A SOURCE as described below and make sure to operate as follow.

A SOURCE	Operation
V.MODE	V.MODE→CH1 The signal of CH1 is synchronized with A sweep V.MODE→CH2 The signal of CH2 is synchronized with A sweep V.MODE→DUAL. ALT When the signals of CH1 and CH2 are superimposed on one another they are synchronized with the A sweep of CH1 and CH2, respectively, but there will be no synchronization when there is no signal V. MODE→DUAL. CHOP No Sync. V. MODE→ADD Synchronized with the signal of CH2 when CH1 + CH2 (CH1 − CH2 at CH2 INV) V.MODE→QUAD, ALT When the signals of CH1 ~ CH4 are superimposed on one another on the CRT screen, the signals will be synchronized with the A sweep of CH1 ~ CH4 respectively but there will be no sync when there is no signal. V.MODE→QUAD, CHOP No Sync.
CH1	The signal of CH1 is synchronized with A sweep
CH2	The signal of CH2 is synchronized with A sweep
EXT 1/1	The signal of CH3 is synchronized with A sweep
EXT 1/10	The signal of CH3 is attenuated to 1/10 and synchronized with A sweep.

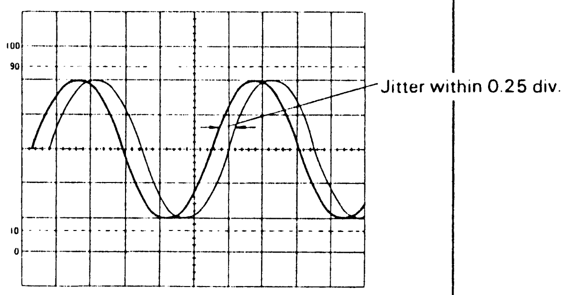
③ Check sync by the lighting of A TRIG'D lamp

ADJUSTMENT

<table>
<tr><th>Item</th><th>Adjustment Control</th><th>P.C.B No.</th><th>Test Equipment</th><th>Control Setting</th><th>Adjustment and Check</th><th>Illustration</th><th>Remark</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>

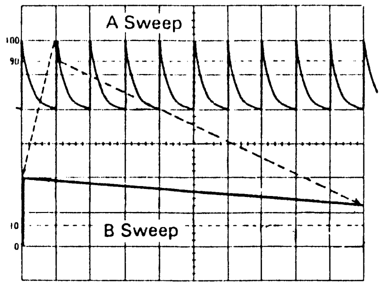
[VIII] Check of trig source (B sweep)
(1) Set H DISPLAY to A, TRIG MODE to AUTO, V MODE to DUAL, ALT and A TRIG SOURCE to V MODE.
(2) Apply different signals to CH1, CH2 and CH4 and superimpose the signals of CH1 and CH2 on one another on the CRT screen and synchronize them by A TRIG LEVEL.
(3) Set H DISPLAY to B DLY'D and operate B SOURCE as described below to check the synchronization.
<table>
<tr><th>B TRIG SOURCE</th><th>Operation</th></tr>
<tr><td>CH1</td><td>The signal of CH1 is synchronized with B sweep.</td></tr>
<tr><td>CH2</td><td>The signal of CH2 is synchronized with B sweep.</td></tr>
<tr><td>EXT 1/1</td><td>The signal of CH4 is synchronized with B sweep.</td></tr>
<tr><td>1/10</td><td>The signal of CH4 is attenuated to 1/10 and synchronized with B sweep.</td></tr>
</table>
(4) Make sure that the B TRIG'D lamp is on.
</td><td></td><td></td></tr>
<tr><td>

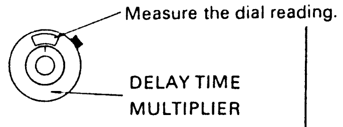
Check of Jitter
</td><td></td><td></td><td>SG503</td><td>H.DISPLAY: A
A.TRIG SOURCE: CH1
TRIG MODE: NORM
A COUPLING: AC
A SWEEP TIME/DIV: 0.02μs
CH1 VOLTS/DIV: 0.1V
CH1 AC-GND-DC: AC
X10 MAG: PULL
CH1 PUSH 50Ω: PUSH
HOLDOFF: NORM</td><td>(1) Apply a sine wave signal of 100 MHz to CH1 INPUT and adjust the oscillator output ct produce a waveform of 4 div on the CRT screen.
(2) Operate A TRIG LEVEL to find a point where the jitter is minimized.
<table>
<tr><td>Jitter</td><td>Less than 0.25 div</td></tr>
</table>
</td><td>



</td><td></td></tr>
<tr><td>

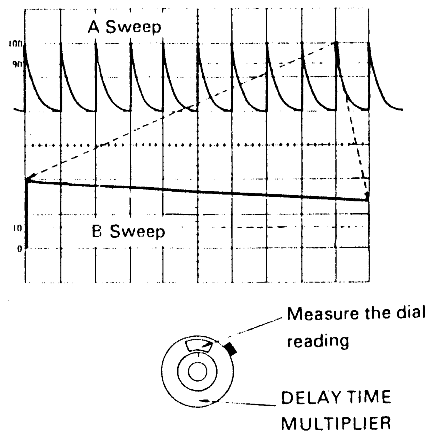
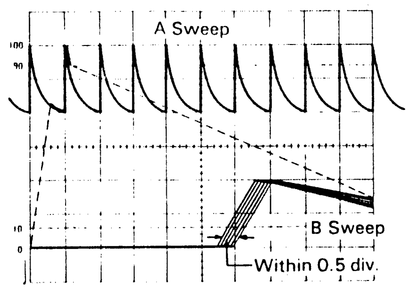
Operational Check of DELAY TIME MULTIPLIER
</td><td></td><td></td><td>TG-501</td><td>H.DISPLAY: ALT
A, B TRIG SOURCE: CH1
TRIG MODE: AUTO
V. MODE: CH1
STARTS AFTER DELAY: PULL
CH1 AC-GND-DC: AC
A SWEEP TIME/DIV: 1ms
B SWEEP TIME/DIV: 5μs</td><td>(1) Apply a marker signal of 1 ms to CH1 INPUT produce a waveform of 2～3 div on the CRT screen.
(2) Operate ↕ TRACE SEP to separate B sweep and A sweep.
(3) Operate ◂▸ POSITION to align the first peak of the waveform with the left end of the screen.
(4) Adjust A INTEN and B INTEN to bring the waveform into the positions where they can be easily visible.
(5) Operate DELAY TIME MULTIPLIER so that the patterns of the screen appear as shown at right (the second peak of the A sweep should be intensity modulated and should be aligned with the left end of B sweep scale) and note the dial reading at this time.</td><td>





</td><td><**Note**>
When TG-501 is used, CH1 VOLTS/DIV should be set to 0.5V and PUSH 50Ω be depressed.</td></tr>
</table>

ADJUSTMENT

<table>
<tr><th>Item</th><th>Adjustment Control</th><th>P.C.B No.</th><th>Test Equipment</th><th>Control Setting</th><th>Adjustment and Check</th><th>Illustration</th><th>Remark</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>(6) Turn DELAY TIME MULTIPLIER and operate ◂▸ POSITION so that what is shown at right will happen at the 10th peak and note the dial reading at this time.
(7) Make the following calculation from the dial reading to make sure that the error is within the specification limits.
(B) − (A) = 8.00 ±0.2
<table><tr><td>Time multiplication error</td><td>within ±2%</td></tr></table></td><td> </td><td></td></tr>
<tr><td>Check of DELAY TIME Jitter</td><td></td><td></td><td>TG-501</td><td>H.DISPLAY: ALT
A TRIG SOURCE: CH1
B TRIG SOURCE: CH2
TRIG MODE: AUTO
V. MODE: CH1
STARTS AFTER DELAY: PULL
B ENDS A: ON
CH1 AC-GND-DC: AC
A SWEEP TIME/DIV: 1ms
B SWEEP TIME/DIV: 1μs</td><td>(1) Apply a marker signal of 1 ms to CH1 INPUT to produce a waveform of 2~3 div on the CRT screen
(2) Operate ⬍ TRACE SEP to separate A sweep and B sweep.
(3) Operate DELAY TIME MULTIPLIER to obtain the patterns as shown at right. (DELAY TIME MULTIPLIER is to be set to about 1.00).
(4) Make sure that the jitter of B sweep is less than 0.5 div at this time.
(5) Make sure that the jitter is also less than 0.5 div at the 10th peak of DELAY TIME MULTIPLIER (9.00).
<table><tr><td>Specification</td><td>Less than 1/20,000</td></tr></table></td><td> </td><td></td></tr>
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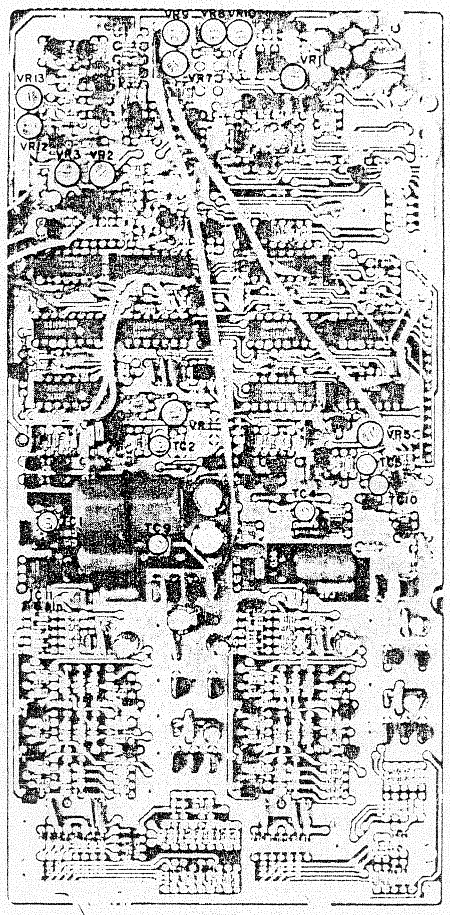
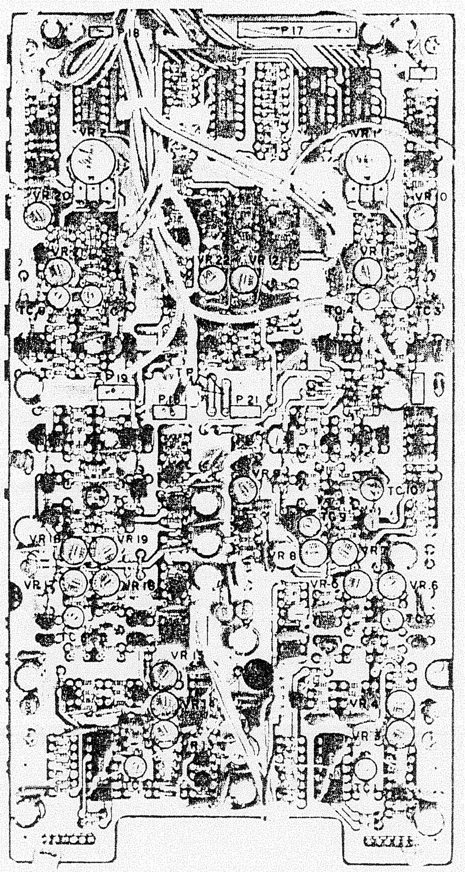
ADJUSTMENT

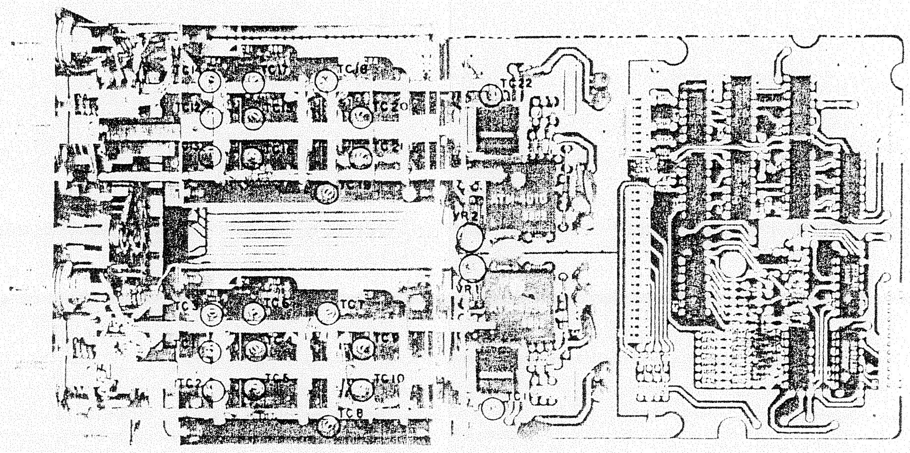
X74-1220-00



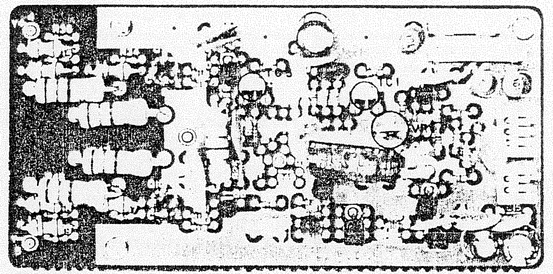
X73-1320-00



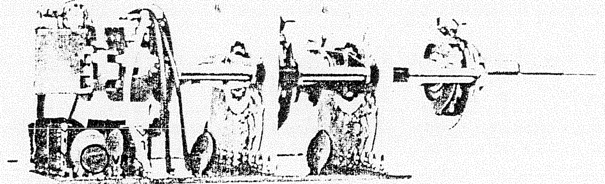
X75-1120-00

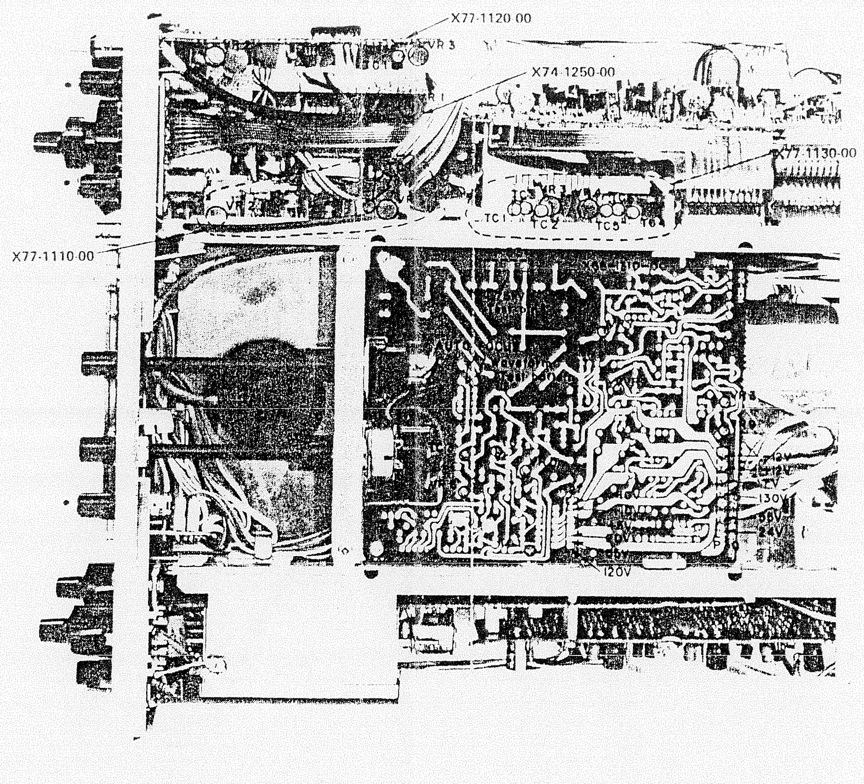


X73-1330-00

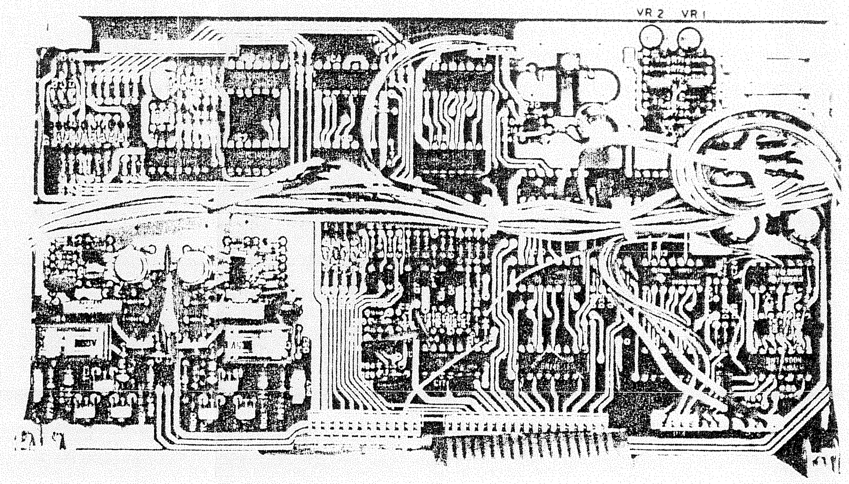


X74-1250-00

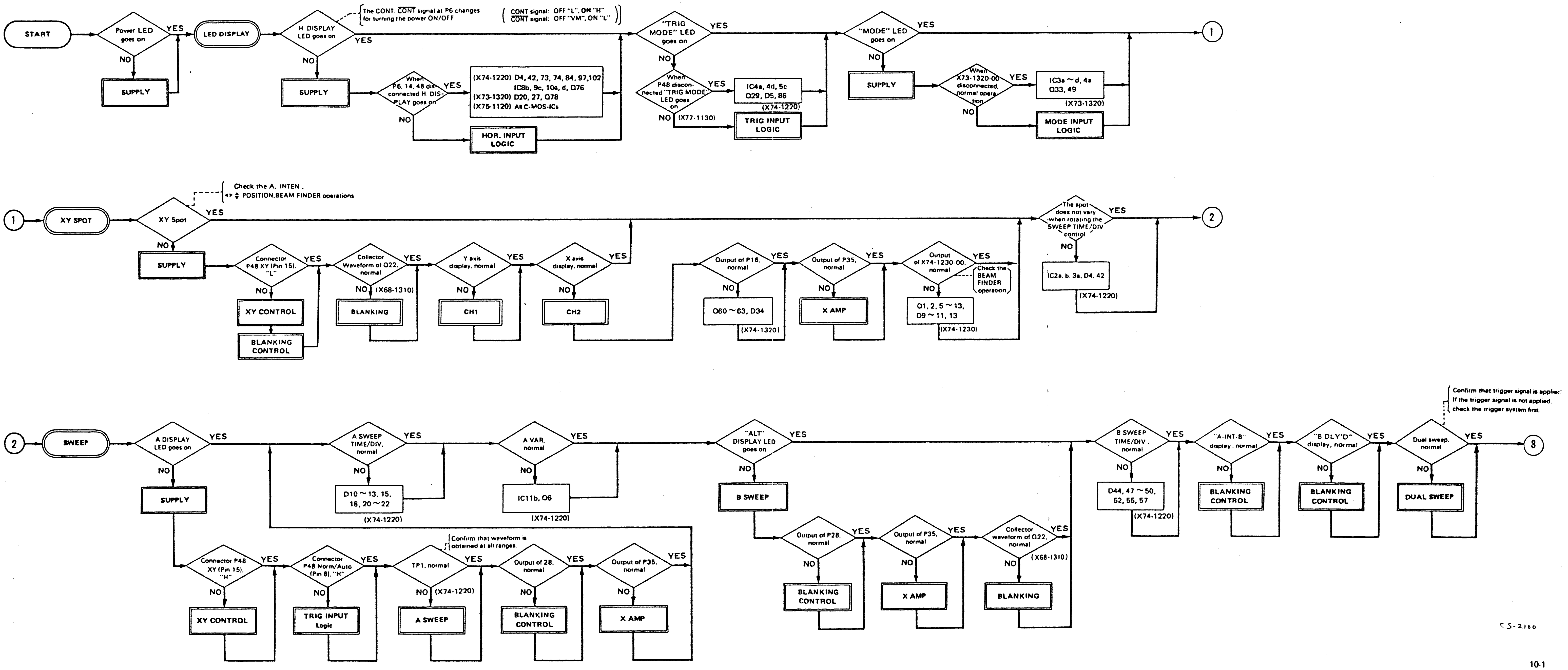



X77-1120-00
VR3
X74-1250-00
X77-1130-00
TC1
TC2
TC5
X77-1110-00
120V
130V

X77-1130-00

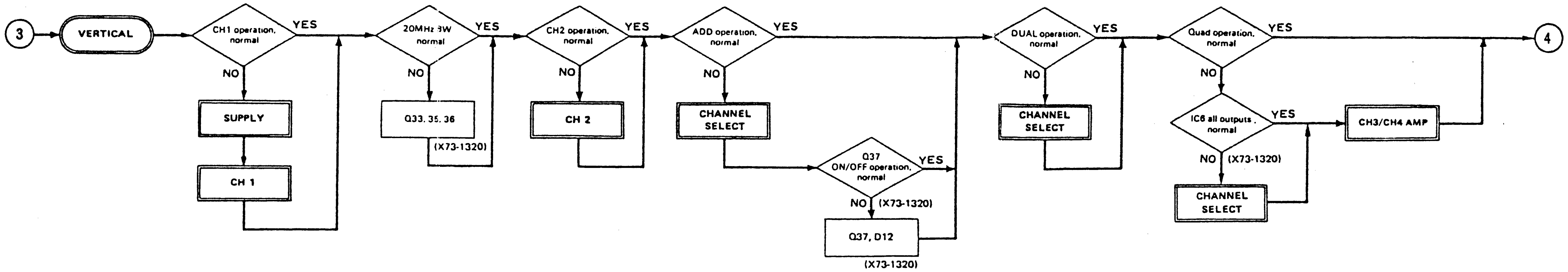


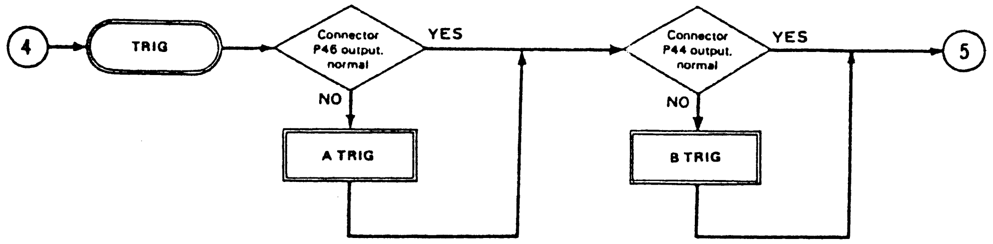
TROUBLESHOOTING

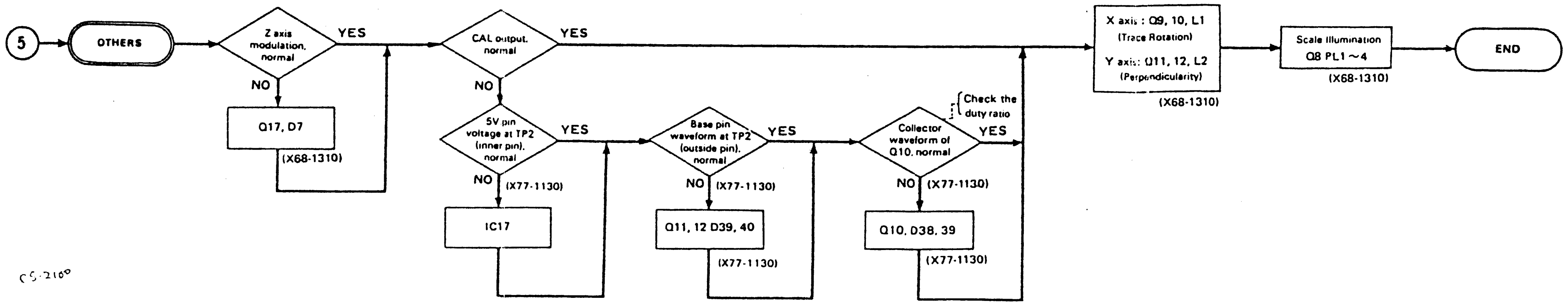

START
Power LED goes on
YES
NO
SUPPLY
LED DISPLAY
H. DISPLAY LED goes on
YES
NO
The CONT. $\overline{\text{CONT}}$ signal at P6 changes for turning the power ON/OFF
(CONT signal: OFF "L", ON "H"
$\overline{\text{CONT}}$ signal: OFF "VM", ON "L")
SUPPLY
When P6, 14, 48 disconnected H. DISPLAY goes on
YES
NO
(X74-1220) D4, 42, 73, 74, 84, 97,102
IC8b, 9c, 10a, d, Q76
(X73-1320) D20, 27, Q78
(X75-1120) All C-MOS-ICs
HOR. INPUT LOGIC
"TRIG MODE" LED goes on
YES
NO
When P48 disconnected "TRIG MODE" LED goes on
YES
NO
(X77-1130)
IC4a, 4d, 5c
Q29, D5, 86
(X74-1220)
TRIG INPUT LOGIC
"MODE" LED goes on
YES
NO
SUPPLY
When X73-1320-00 disconnected, normal operation
YES
NO
IC3a ~ d, 4a
Q33, 49
(X73-1320)
MODE INPUT LOGIC
1
1
XY SPOT
XY Spot
YES
NO
Check the A. INTEN .
◂▸ ▴▾ POSITION, BEAM FINDER operations
SUPPLY
Connector P48 XY (Pin 15), "L"
YES
NO
XY CONTROL
BLANKING CONTROL
Collector Waveform of Q22, normal
YES
NO
(X68-1310)
BLANKING
Y axis display, normal
YES
NO
CH1
X axis display, normal
YES
NO
CH2
Output of P16, normal
YES
NO
Q60 ~ 63, D34
(X74-1320)
Output of P35, normal
YES
NO
X AMP
Output of X74-1230-00, normal
YES
NO
Check the BEAM FINDER operation
Q1, 2, 5 ~ 13,
D9 ~ 11, 13
(X74-1230)
The spot does not vary when rotating the SWEEP TIME/DIV control
YES
NO
IC2a, b, 3a, D4, 42
(X74-1220)
2
2
SWEEP
A DISPLAY LED goes on
YES
NO
SUPPLY
A SWEEP TIME/DIV, normal
YES
NO
D10 ~ 13, 15,
18, 20 ~ 22
(X74-1220)
A VAR, normal
YES
NO
IC11b, Q6
(X74-1220)
Connector P48 XY (Pin 15), "H"
YES
NO
XY CONTROL
Connector P48 Norm/Auto (Pin 8), "H"
YES
NO
TRIG INPUT Logic
Confirm that waveform is obtained at all ranges.
TP1, normal
YES
NO
(X74-1220)
A SWEEP
Output of 28, normal
YES
NO
BLANKING CONTROL
Output of P35, normal
YES
NO
X AMP
"ALT" DISPLAY LED goes on
YES
NO
B SWEEP
Output of P28, normal
YES
NO
BLANKING CONTROL
Output of P35, normal
YES
NO
X AMP
Collector waveform of Q22, normal
YES
NO
(X68-1310)
BLANKING
B SWEEP TIME/DIV, normal
YES
NO
D44, 47 ~ 50,
52, 55, 57
(X74-1220)
"A-INT-B" display, normal
YES
NO
BLANKING CONTROL
"B DLY'D" display, normal
YES
NO
BLANKING CONTROL
Dual sweep, normal
YES
NO
DUAL SWEEP
Confirm that trigger signal is applied
If the trigger signal is not applied, check the trigger system first.
3

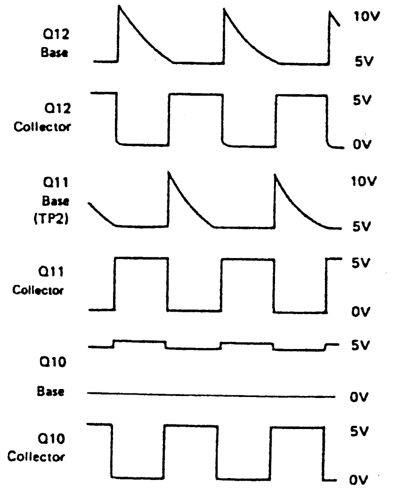
CS-2160

TROUBLESHOOTING


3
VERTICAL
CH1 operation, normal
YES
NO
SUPPLY
CH 1
20MHz BW normal
YES
NO
Q33, 35, 36
(X73-1320)
CH2 operation, normal
YES
NO
CH 2
ADD operation, normal
YES
NO
CHANNEL SELECT
Q37 ON/OFF operation, normal
YES
NO
(X73-1320)
Q37, D12
(X73-1320)
DUAL operation, normal
YES
NO
CHANNEL SELECT
Quad operation, normal
YES
NO
IC6 all outputs, normal
YES
NO
(X73-1320)
CHANNEL SELECT
CH3/CH4 AMP
4


4
TRIG
Connector P46 output, normal
YES
NO
A TRIG
Connector P44 output, normal
YES
NO
B TRIG
5


5
OTHERS
Z axis modulation, normal
YES
NO
Q17, D7
(X68-1310)
CAL output, normal
YES
NO
5V pin voltage at TP2 (inner pin), normal
YES
NO
(X77-1130)
IC17
Base pin waveform at TP2 (outside pin), normal
YES
NO
(X77-1130)
Q11, 12 D39, 40
(X77-1130)
Check the duty ratio
Collector waveform of Q10, normal
YES
NO
(X77-1130)
Q10, D38, 39
(X77-1130)
X axis : Q9, 10, L1
(Trace Rotation)
Y axis: Q11, 12, L2
(Perpendicularity)
(X68-1310)
Scale Illumination
Q8 PL1 ~ 4
(X68-1310)
END


Q12 Base
10V
5V
Q12 Collector
5V
0V
Q11 Base (TP2)
10V
5V
Q11 Collector
5V
0V
Q10 Base
5V
0V
Q10 Collector
5V
0V

CAL CIRCUIT WAVEFORMS

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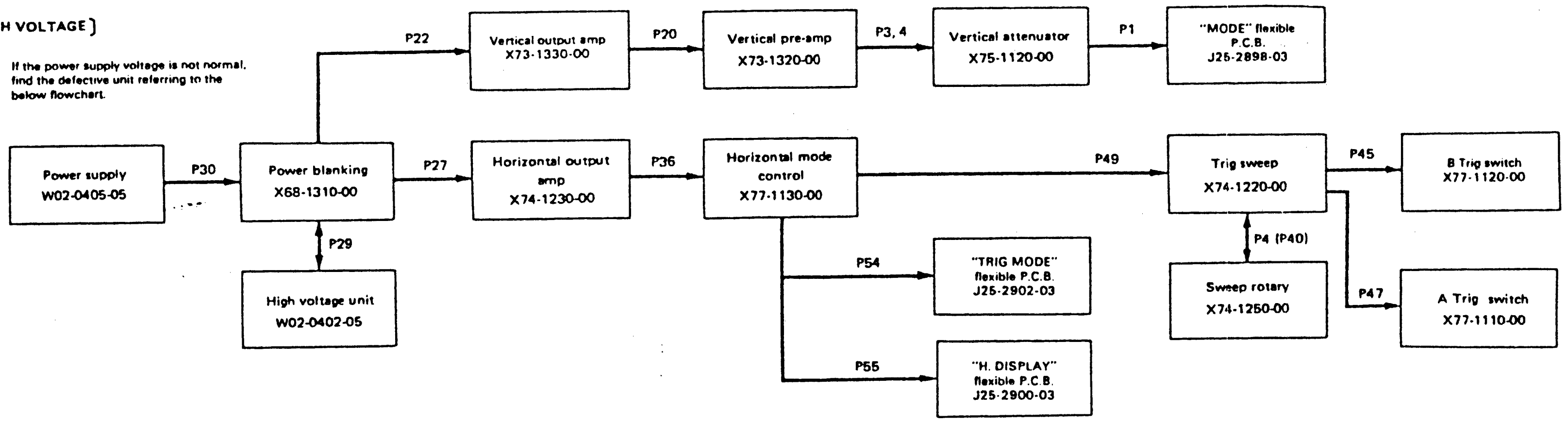
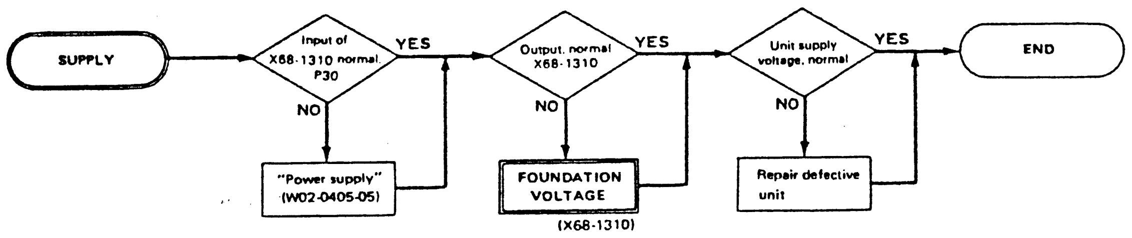
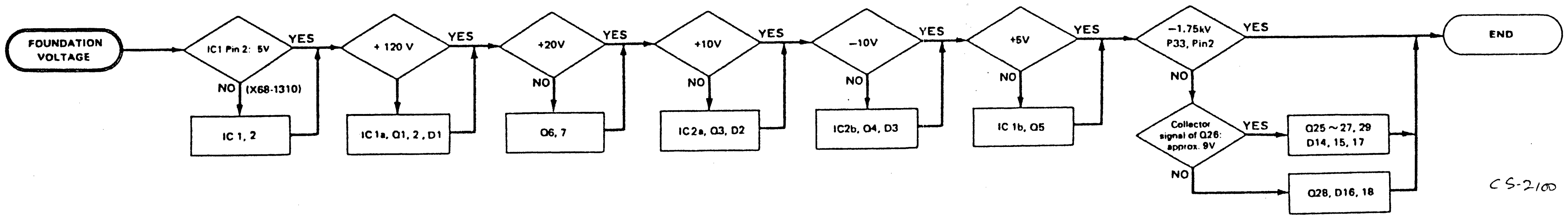
TROUBLESHOOTING

(POWER SUPPLY OF EACH VOLTAGE)

If the power supply voltage is not normal, find the defective unit referring to the below flowchart.


Power supply
W02-0405-05
P30
Power blanking
X68-1310-00
P29
High voltage unit
W02-0402-05
P22
Vertical output amp
X73-1330-00
P20
Vertical pre-amp
X73-1320-00
P3, 4
Vertical attenuator
X75-1120-00
P1
"MODE" flexible
P.C.B.
J25-2898-03
P27
Horizontal output
amp
X74-1230-00
P36
Horizontal mode
control
X77-1130-00
P49
Trig sweep
X74-1220-00
P45
B Trig switch
X77-1120-00
P4 (P40)
Sweep rotary
X74-1250-00
P47
A Trig switch
X77-1110-00
P54
"TRIG MODE"
flexible P.C.B.
J25-2902-03
P55
"H. DISPLAY"
flexible P.C.B.
J25-2900-03


SUPPLY
Input of
X68-1310 normal
P30
YES
NO
"Power supply"
(W02-0405-05)
Output, normal
X68-1310
YES
NO
FOUNDATION
VOLTAGE
(X68-1310)
Unit supply
voltage, normal
YES
NO
Repair defective
unit
END


FOUNDATION
VOLTAGE
IC1 Pin 2: 5V
YES
NO (X68-1310)
IC 1, 2
+ 120 V
YES
IC 1a, Q1, 2, D1
+20V
YES
NO
Q6, 7
+10V
YES
NO
IC 2a, Q3, D2
−10V
YES
NO
IC2b, Q4, D3
+5V
YES
NO
IC 1b, Q5
−1.75kV
P33, Pin2
YES
NO
Collector
signal of Q26:
approx. 9V
YES
Q25 ~ 27, 29
D14, 15, 17
NO
Q28, D16, 18
END

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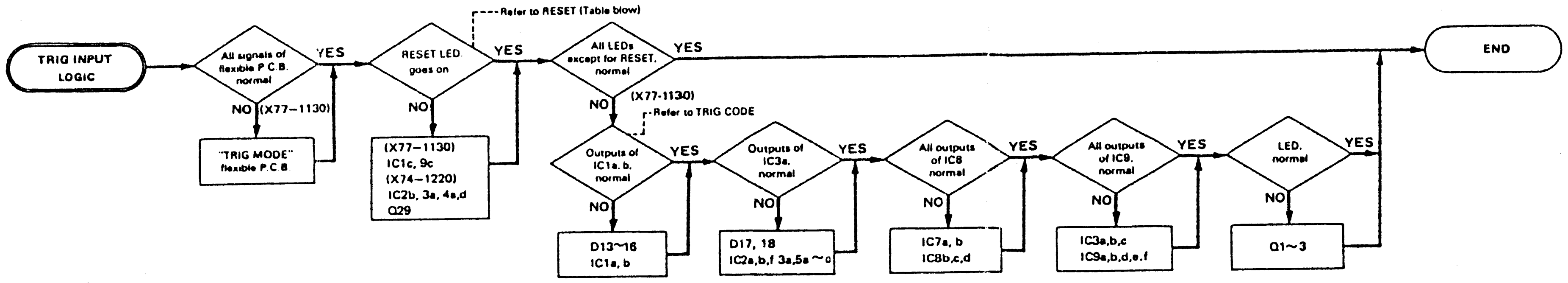
TROUBLESHOOTING


TRIG INPUT LOGIC
All signals of flexible P.C.B. normal
YES
NO
(X77–1130)
"TRIG MODE" flexible P.C.B.
RESET LED goes on
Refer to RESET (Table blow)
YES
NO
(X77–1130)
IC1c, 9c
(X74–1220)
IC2b, 3a, 4a,d
Q29
All LEDs except for RESET. normal
YES
NO
(X77-1130)
Refer to TRIG CODE
Outputs of IC1a. b. normal
YES
NO
D13~16
IC1a, b
Outputs of IC3a. normal
YES
NO
D17, 18
IC2a,b,f 3a,5a ~o
All outputs of IC8 normal
YES
NO
IC7a, b
IC8b,c,d
All outputs of IC9. normal
YES
NO
IC3a,b,c
IC9a,b,d,e.f
LED. normal
YES
NO
Q1~3
END

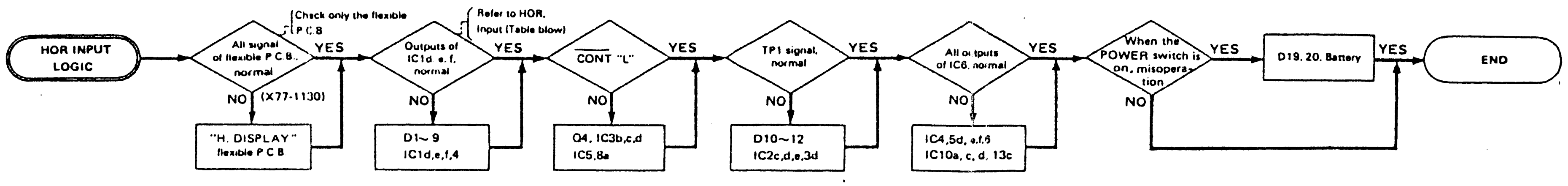
RESET (TRIG MODE "SINGLE")

RESET PUSH (TRIG MODE SINGLE).	Qt	Qt + 1	
	P48 10Pin	IC2b 3 Pin	IC4a 3 Pin
	↓	L	L

TRIG CODE

TRIG MODE PUSH	Qt			Qt + 1											
	IC1		IC3	IC7				IC8-4	IC8-11	IC8-10	IC9				
	4 Pin	2 Pin	3 Pin	13 Pin	12 Pin	1 Pin	2 Pin	IC5-3	IC5-5	IC5-7	8 Pin	10 Pin	12 Pin	4 Pin	2 Pin
AUTO	↑	L	↑	H	L	L	H	L	H	H	H	L	L	H	H
NORM	L	↑	↑	L	H	H	L	H	L	H	L	H	L	L	H
SINGLE	↑	↑	↑	H	L	H	L	H	H	L	L	L	H	H	L

Qt : Logical value when the switch is depressed.
Qt + 1. Logical value after the switch is depressed.


HOR INPUT LOGIC
All signal of flexible P.C.B.. normal
Check only the flexible P.C.B
YES
NO
(X77-1130)
"H. DISPLAY" flexible P.C.B.
Outputs of IC1d. e. f. normal
Refer to HOR. Input (Table blow)
YES
NO
D1~ 9
IC1d,e,f,4
$\overline{\text{CONT}}$ "L"
YES
NO
Q4, IC3b,c,d
IC5,8a
TP1 signal, normal
YES
NO
D10~12
IC2c,d,e,3d
All outputs of IC6, normal
YES
NO
IC4,5d, e.f.6
IC10a, c, d, 13c
When the POWER switch is on, misoperation
YES
NO
D19, 20, Battery
YES
END

HOR. INPUT

H.DISPLAY PUSH	Qt				Qt + 1										
	IC1 OUTPUT			TP1	IC5 1 pin 15 pin	IC4 2 pin IC5 13 pin	IC4 5 pin IC5 11 pin	IC4 7 pin IC5 9 pin	IC6 OUTPUT						
	12f	10e	8d						2	3	4	5	6	7	OTHER OUTPUT
A	L	L	↑	↑	L	L	L	H	L	H	H	H	H	H	H
ALT	L	↑	L	↑	L	L	H	L	H	L	H	H	H	H	H
A-INT-B	L	↑	↑	↑	L	L	H	H	H	H	L	H	H	H	H
B	↑	L	L	↑	L	H	L	L	H	H	H	L	H	H	H
DUAL	↑	L	↑	↑	L	H	L	H	H	H	H	H	L	H	H
X-Y	↑	↑	L	↑	L	H	H	L	H	H	H	H	H	L	H

Qt . Logical value when the switch is depressed.
Qt + 1: Logical value after the switch is depressed.

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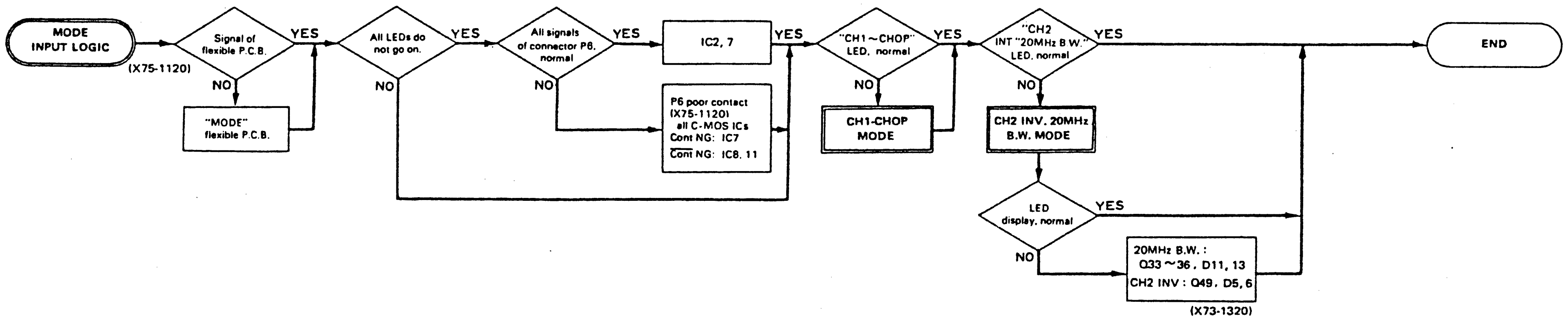
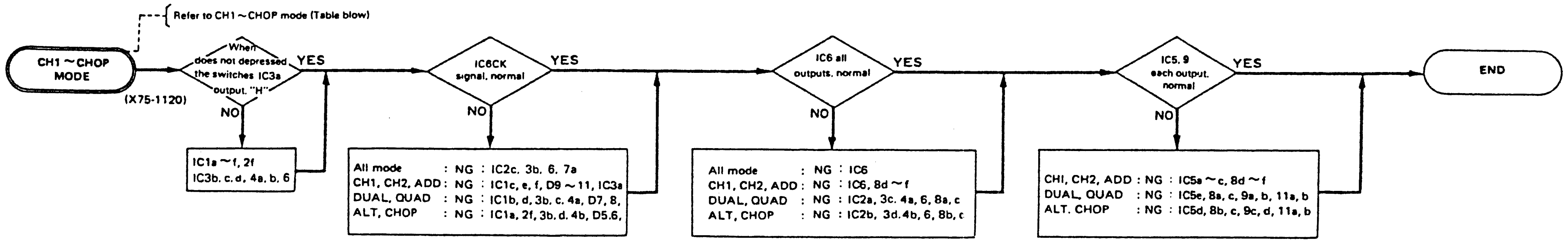
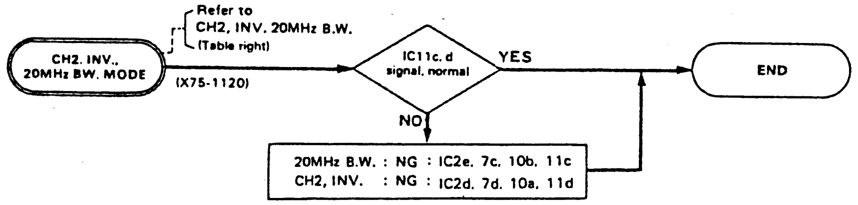
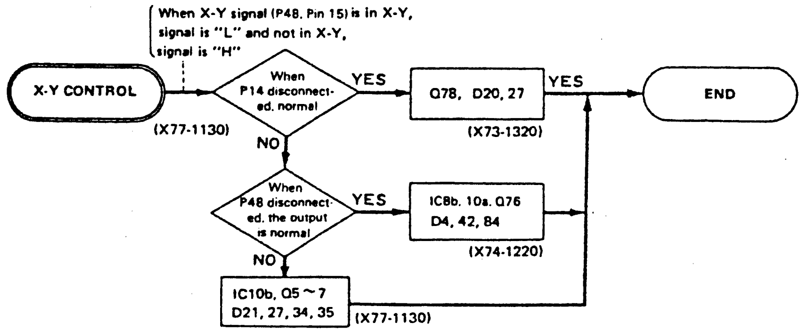
TROUBLESHOOTING


MODE INPUT LOGIC
(X75-1120)
Signal of flexible P.C.B.
YES
NO
"MODE" flexible P.C.B.
All LEDs do not go on.
YES
NO
All signals of connector P6. normal
YES
NO
IC2, 7
YES
P6 poor contact
(X75-1120)
all C-MOS ICs
Cont NG: IC7
$\overline{\text{Cont}}$ NG: IC8, 11
"CH1 ~ CHOP" LED, normal
YES
NO
CH1-CHOP MODE
"CH2 INT "20MHz B.W." LED, normal
YES
NO
CH2 INV. 20MHz B.W. MODE
LED display, normal
YES
NO
20MHz B.W. : Q33 ~ 36, D11, 13
CH2 INV : Q49, D5, 6
(X73-1320)
END


Refer to CH1 ~ CHOP mode (Table blow)
CH1 ~ CHOP MODE
(X75-1120)
When does not depressed the switches IC3a output, "H"
YES
NO
IC1a ~ f, 2f
IC3b. c. d, 4a. b. 6
IC6CK signal, normal
YES
NO
All mode : NG : IC2c. 3b. 6. 7a
CH1, CH2, ADD : NG : IC1c, e, f, D9 ~ 11, IC3a
DUAL, QUAD : NG : IC1b, d, 3b. c. 4a, D7, 8,
ALT, CHOP : NG : IC1a, 2f, 3b. d. 4b, D5.6,
IC6 all outputs, normal
YES
NO
All mode : NG : IC6
CH1, CH2, ADD : NG : IC6, 8d ~ f
DUAL, QUAD : NG : IC2a, 3c. 4a, 6, 8a, c
ALT, CHOP : NG : IC2b, 3d. 4b, 6, 8b, c
IC5, 9 each output, normal
YES
NO
CHI, CH2, ADD : NG : IC5a ~ c, 8d ~ f
DUAL, QUAD : NG : IC5e, 8a, c, 9a, b, 11a, b
ALT. CHOP : NG : IC5d, 8b, c, 9c, d, 11a, b
END


Refer to CH2, INV. 20MHz B.W. (Table right)
CH2. INV., 20MHz BW. MODE
(X75-1120)
IC11c. d signal, normal
YES
NO
20MHz B.W. : NG : IC2e. 7c. 10b. 11c
CH2, INV. : NG : IC2d. 7d. 10a. 11d
END


When X-Y signal (P48. Pin 15) is in X-Y, signal is "L" and not in X-Y, signal is "H"
X-Y CONTROL
(X77-1130)
When P14 disconnected. normal
YES
NO
Q78, D20, 27
(X73-1320)
YES
When P48 disconnected. the output is normal
YES
NO
IC8b. 10a. Q76 D4, 42, 84
(X74-1220)
IC10b, Q5 ~ 7 D21, 27, 34, 35
(X77-1130)
END

CH2 INV.

	Qt	Qt + 1
CH2 NV PUSH	IC10a INPUT	IC10a OUTPUT
	(T)	(Qa)
	↑	$\overline{Qat}$

20MHz B.W.

	Qt	Qt + 1
20MHz B.W PUSH	IC 10b INPUT	IC10b OUTPUT
	(T)	(Qb)
	↑	$\overline{Qbt}$

CHI ~ CHOP MODE

"MODE" PUSH	Qt				Qt + I														
	IC3b IN / OUT			IC6	CHI / CH2 / ADD						IC6	DUAL / QUAD				ALT / CHOP			
	IN Pin 5	IN Pin 6	OUT Pin 4	CK	IC6			IC5			Q2	IC4a Qa	IC6 Qo	IC9 OUTPUT		IC4b Qb	IC6 Q1	IC9 OUTPUT	
					Q5	Q4	Q3	a	b	c				b	a			c	d
CHI	L	↑	↓	↑	H	L	L	L	H	H	H	Qat	Qat	H	H	Qbt	Qbt	H	H
CH2	L	↑	↓	↑	L	H	L	H	L	H	H	Qat	Qat	H	H	Qbt	Qbt	H	H
DUAL	↑	L	↓	↑	L	L	L	H	H	H	L	L	L	L	H	Qbt	Qbt	Q1t	Q1t
ADD	L	↑	↓	↑	L	L	H	H	H	L	H	Qat	Qat	H	H	Qbt	Qbt	H	H
QUAD	↑	L	↓	↑	L	L	L	H	H	H	L	H	H	H	L	Qbt	Qbt	Q1t	Q1t
ALT	↑	L	↓	↑	L	L	L	H	H	H	L	Qat	Qat	Qot	$\overline{Qot}$	H	L	L	H
CHOP	↑	L	↓	↑	L	L	L	H	H	H	L	Qat	Qat	Qot	$\overline{Qot}$	L	H	H	L

Qt : Logical value when the switch is depressed.
Qt + 1 : Logical value after the switch is depressed.
Qkt : Indicates that Qkt which is the logical value before the switch is depressed is output when the switch is depressed.

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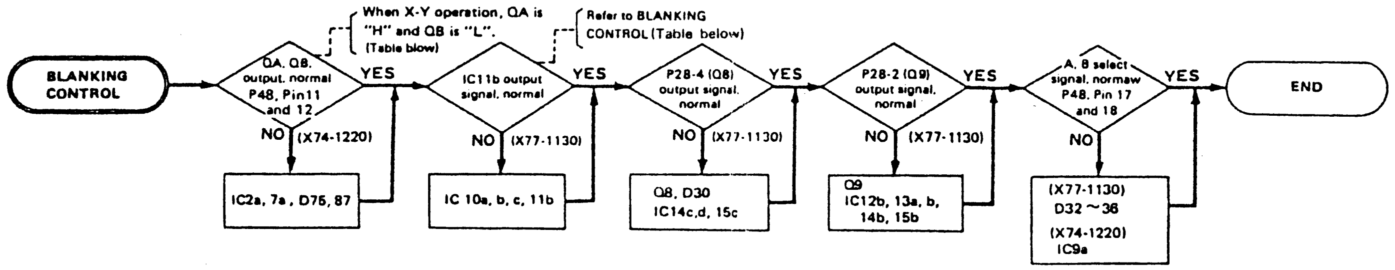
TROUBLESHOOTING


BLANKING CONTROL
When X-Y operation, QA is "H" and QB is "L". (Table blow)
QA, QB, output, normal P48, Pin11 and 12
YES
NO
(X74-1220)
IC2a, 7a, D75, 87
Refer to BLANKING CONTROL (Table below)
IC11b output signal, normal
YES
NO
(X77-1130)
IC 10a, b, c, 11b
P28-4 (Q8) output signal, normal
YES
NO
(X77-1130)
Q8, D30
IC14c,d, 15c
P28-2 (Q9) output signal, normal
YES
NO
(X77-1130)
Q9
IC12b, 13a, b, 14b, 15b
A, B select signal, normaw P48, Pin 17 and 18
YES
NO
(X77-1130)
D32 ~ 36
(X74-1220)
IC9a
END

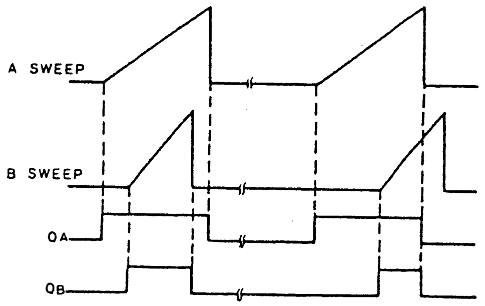
BLANKING CONTROL

H DISPLAY	P48 X-Y BUFFER 15Pin	IC11b				IC12b OUT	P28		P48	
		IN		OUT			A blank-ing 4 Pin	B blank-ing 2 Pin	MA 17Pin	MB 18Pin
		$\overline{S}$	$\overline{R}$	Q	$\overline{Q}$					
A	H	L	H	H	L	L	$\overline{QA}$	H	H	L
ALT	H	H	H	TOGGLE		•1	$\overline{QA}$•2	$\overline{QB}$	TOGGLE	
A-INT-B	H	L	L	H	H	QA	$\overline{QA}$	$\overline{QB}$	H	L
B-DLY'D	H	H	L	L	H	H	H	$\overline{QB}$	L	H
DUAL	H	H	H	QA TOGGLE		$\overline{Q11b}$	$\overline{QA}$•2	$\overline{QB}$•2	QA TOGGLE	
X-Y	L	L	H	H	L	L	L	H	L	L

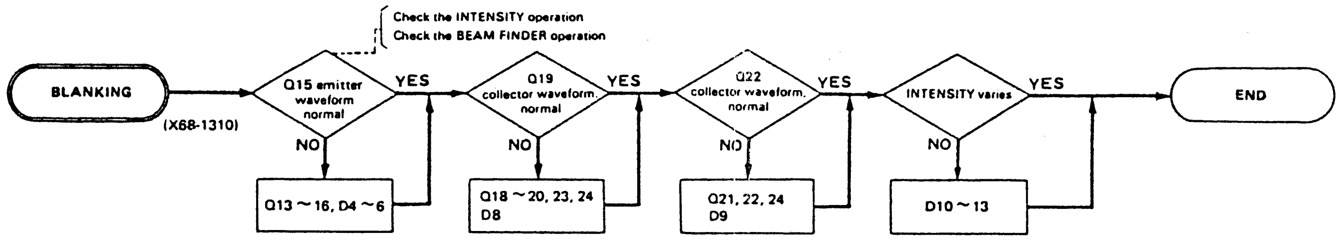
*1 Complex waveform IC 11b and QA signals.

*2 Complex waveform IC11b output. When CHOP operation, output of P28 is complex CHOP signal waveform.

The $\overline{QA}$ and $\overline{QB}$ in the table show the reverse phase of QA and AB described


A SWEEP
B SWEEP
QA
QB

RELATIONSHIP BETWEEN A, B SWEEP AND QA, QB


BLANKING
(X68-1310)
Check the INTENSITY operation
Check the BEAM FINDER operation
Q15 emitter waveform normal
YES
NO
Q13 ~ 16, D4 ~ 6
Q19 collector waveform, normal
YES
NO
Q18 ~ 20, 23, 24
D8
Q22 collector waveform, normal
YES
NO
Q21, 22, 24
D9
INTENSITY varies
YES
NO
D10 ~ 13
END

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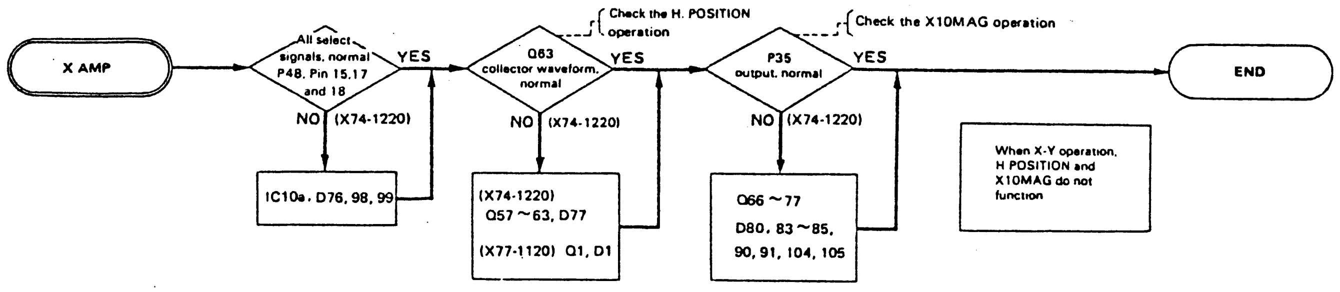
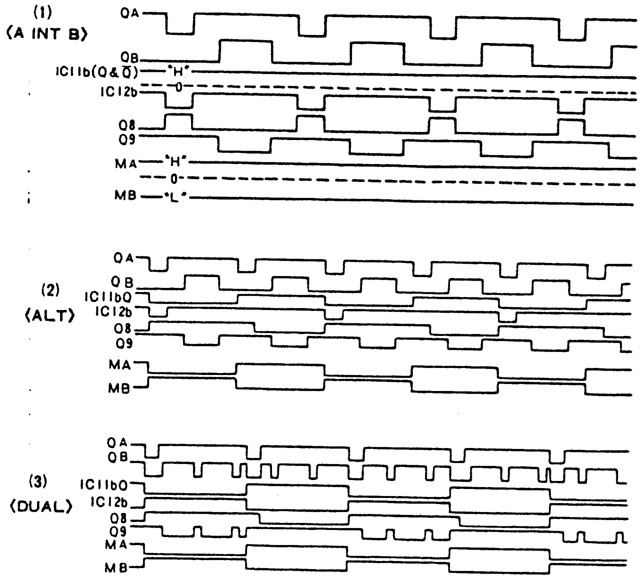
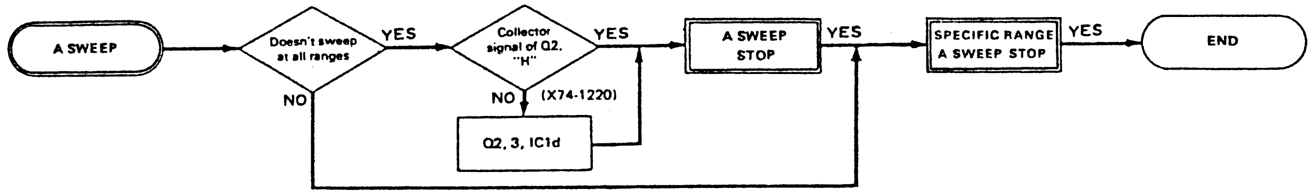
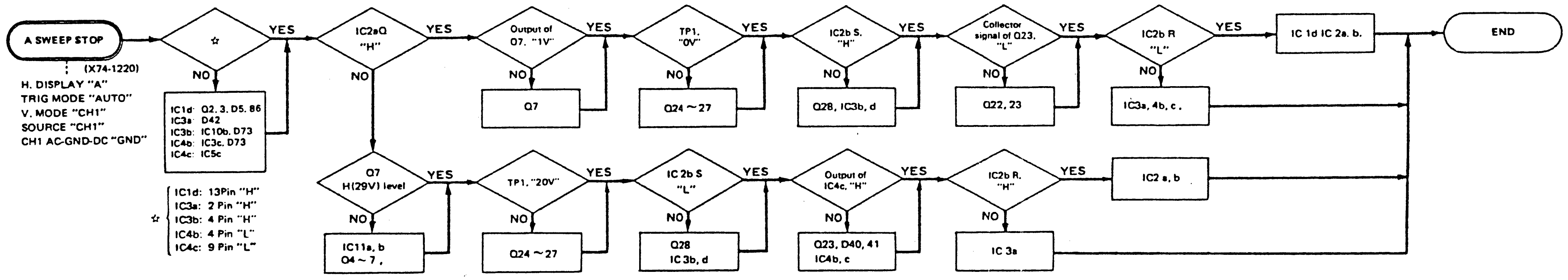

X AMP
All select signals, normal P48, Pin 15,17 and 18
YES
NO
(X74-1220)
IC10a, D76, 98, 99
Check the H. POSITION operation
Q63 collector waveform, normal
YES
NO
(X74-1220)
(X74-1220)
Q57 ~ 63, D77
(X77-1120) Q1, D1
Check the X10MAG operation
P35 output, normal
YES
NO
(X74-1220)
Q66 ~ 77
D80, 83 ~ 85, 90, 91, 104, 105
END
When X-Y operation, H POSITION and X10MAG do not function


(1)
(A INT B)
QA
QB
IC11b(Q & $\overline{Q}$)
"H"
0
IC12b
Q8
Q9
MA
"H"
0
MB
"L"
(2)
(ALT)
QA
QB
IC11bQ
IC12b
Q8
Q9
MA
MB
(3)
(DUAL)
QA
QB
IC11bQ
IC12b
Q8
Q9
MA
MB

BLANKING CONTROL

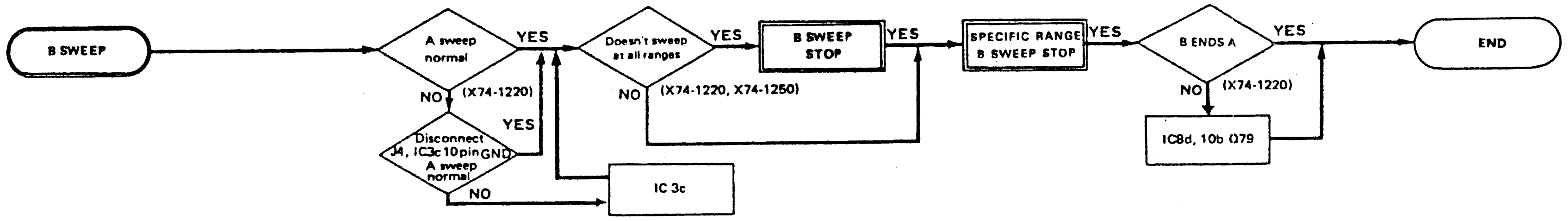
TROUBLESHOOTING

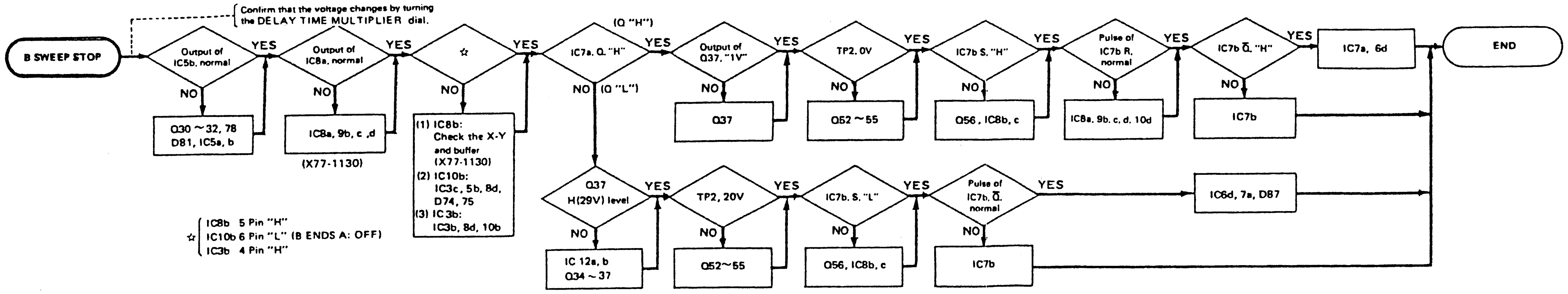

A SWEEP
Doesn't sweep at all ranges
YES
NO
Collector signal of Q2. "H"
YES
NO
(X74-1220)
Q2, 3, IC1d
A SWEEP STOP
YES
SPECIFIC RANGE A SWEEP STOP
YES
END


A SWEEP STOP
☆
YES
NO
IC1d: Q2, 3, D5, 86
IC3a: D42
IC3b: IC10b, D73
IC4b: IC3c, D73
IC4c: IC5c
IC2aQ "H"
YES
NO
Output of Q7. "1V"
YES
NO
Q7
TP1. "0V"
YES
NO
Q24 ~ 27
IC2b S. "H"
YES
NO
Q28, IC3b, d
Collector signal of Q23. "L"
YES
NO
Q22, 23
IC2b R "L"
YES
NO
IC3a, 4b, c.
IC 1d IC 2a. b.
END
Q7 H(29V) level
YES
NO
IC11a, b Q4 ~ 7,
TP1. "20V"
YES
NO
Q24 ~ 27
IC 2b S "L"
YES
NO
Q28 IC 3b, d
Output of IC4c. "H"
YES
NO
Q23, D40, 41 IC4b, c
IC2b R. "H"
YES
NO
IC 3a
IC2 a, b

(X74-1220)
H. DISPLAY "A"
TRIG MODE "AUTO"
V. MODE "CH1"
SOURCE "CH1"
CH1 AC-GND-DC "GND"

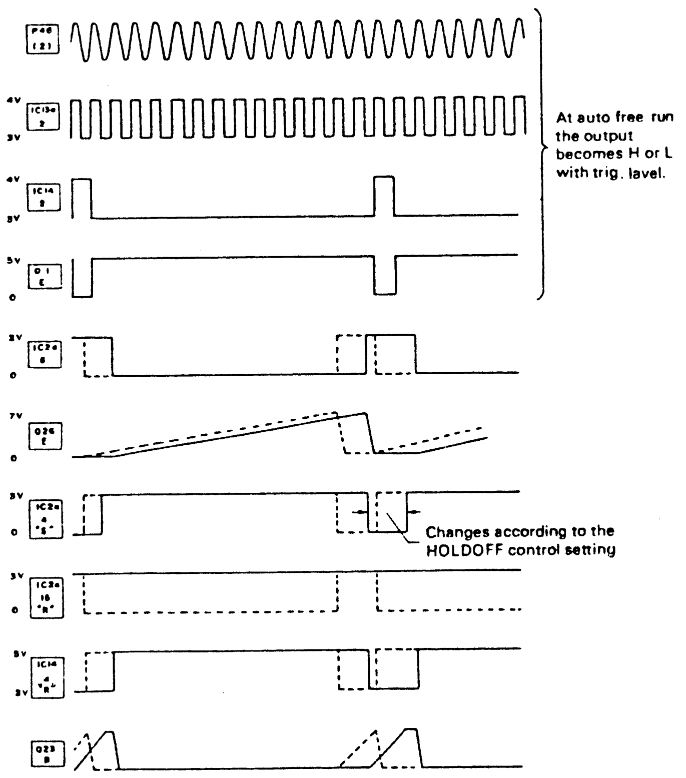
☆ IC1d: 13Pin "H"
IC3a: 2 Pin "H"
IC3b: 4 Pin "H"
IC4b: 4 Pin "L"
IC4c: 9 Pin "L"


B SWEEP
A sweep normal
YES
NO
(X74-1220)
Disconnect J4, IC3c 10pin GND A sweep normal
YES
NO
IC 3c
Doesn't sweep at all ranges
YES
NO
(X74-1220, X74-1250)
B SWEEP STOP
YES
SPECIFIC RANGE B SWEEP STOP
YES
B ENDS A
YES
NO
(X74-1220)
IC8d, 10b Q79
END


Confirm that the voltage changes by turning the DELAY TIME MULTIPLIER dial.
B SWEEP STOP
Output of IC5b. normal
YES
NO
Q30 ~ 32, 78 D81, IC5a, b
Output of IC8a. normal
YES
NO
IC8a, 9b, c, d
(X77-1130)
☆
YES
NO
(1) IC8b: Check the X-Y and buffer (X77-1130)
(2) IC10b: IC3c, 5b, 8d, D74, 75
(3) IC3b: IC3b, 8d, 10b
IC7a. Q. "H"
(Q "H")
YES
NO
(Q "L")
Output of Q37. "1V"
YES
NO
Q37
TP2. 0V
YES
NO
Q52 ~ 55
IC7b S. "H"
YES
NO
Q56, IC8b, c
Pulse of IC7b R. normal
YES
NO
IC8a, 9b, c, d, 10d
IC7b $\overline{Q}$. "H"
YES
NO
IC7b
IC7a, 6d
END
Q37 H(29V) level
YES
NO
IC 12a, b Q34 ~ 37
TP2, 20V
YES
NO
Q52~55
IC7b. S. "L"
YES
NO
Q56, IC8b, c
Pulse of IC7b. $\overline{Q}$. normal
YES
NO
IC7b
IC6d, 7a, D87

☆ IC8b 5 Pin "H"
IC10b 6 Pin "L" (B ENDS A: OFF)
IC3b 4 Pin "H"

Waveform in Sweep circuit (X74-1220-00)
(Input signal 1 kHz, SWEEP TIME 1 ms/div)


P46 (2)
4V
IC13a 2
3V
4V
IC14 2
3V
5V
Q1 E
0
3V
IC2a 6
0
7V
Q26 E
0
3V
IC2a 4 "S"
0
3V
IC2a 10 "R"
0
5V
IC14 4 "R"
3V
Q23 B

At auto free run the output becomes H or L with trig. lavel.

Changes according to the HOLDOFF control setting

Broke-line auto freerun
(at non-signal)

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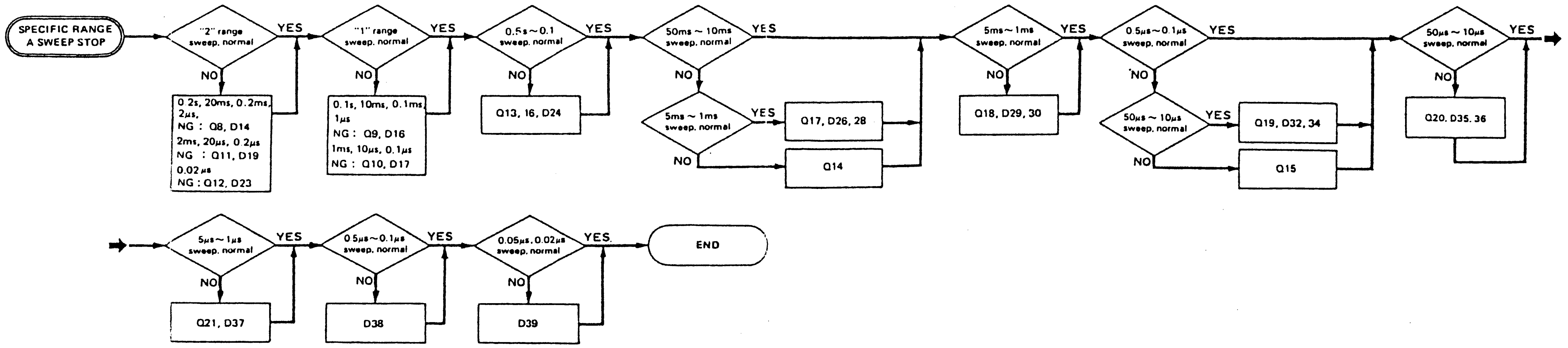
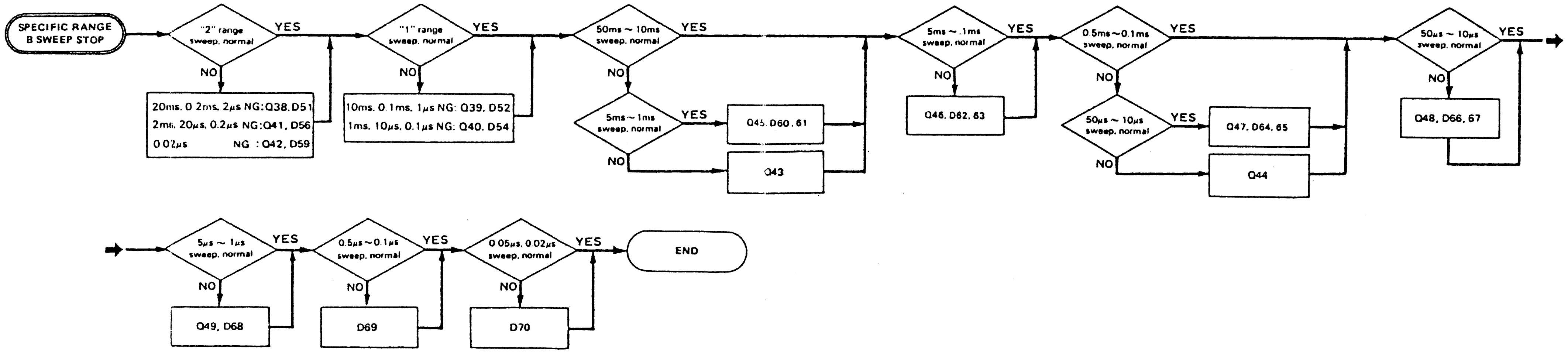
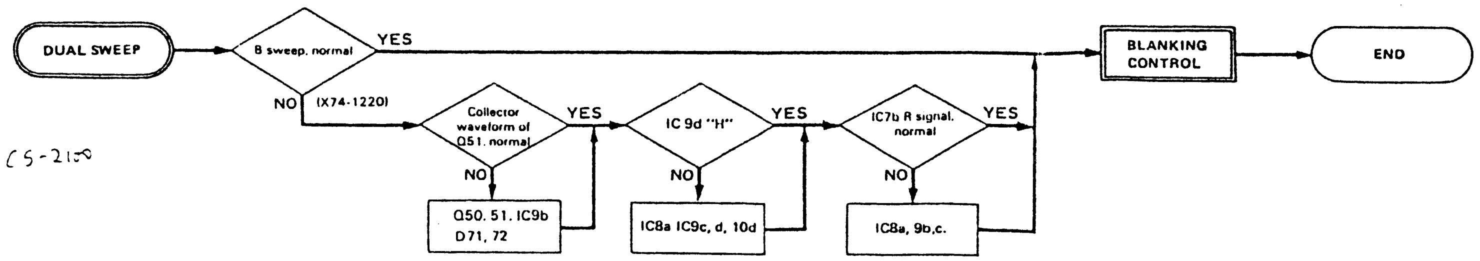
TROUBLESHOOTING


SPECIFIC RANGE A SWEEP STOP
"2" range sweep, normal
YES
NO
0.2s, 20ms, 0.2ms, 2μs, NG : Q8, D14
2ms, 20μs, 0.2μs NG : Q11, D19
0.02μs NG : Q12, D23
"1" range sweep, normal
0.1s, 10ms, 0.1ms, 1μs NG : Q9, D16
1ms, 10μs, 0.1μs NG : Q10, D17
0.5s ~ 0.1 sweep, normal
Q13, 16, D24
50ms ~ 10ms sweep, normal
5ms ~ 1ms sweep, normal
Q17, D26, 28
Q14
5ms ~ 1ms sweep, normal
Q18, D29, 30
0.5μs ~ 0.1μs sweep, normal
50μs ~ 10μs sweep, normal
Q19, D32, 34
Q15
50μs ~ 10μs sweep, normal
Q20, D35, 36
5μs ~ 1μs sweep, normal
Q21, D37
0.5μs ~ 0.1μs sweep, normal
D38
0.05μs, 0.02μs sweep, normal
D39
END


SPECIFIC RANGE B SWEEP STOP
"2" range sweep, normal
YES
NO
20ms, 0.2ms, 2μs NG:Q38, D51
2ms, 20μs, 0.2μs NG:Q41, D56
0.02μs NG : Q42, D59
"1" range sweep, normal
10ms, 0.1ms, 1μs NG: Q39, D52
1ms, 10μs, 0.1μs NG: Q40, D54
50ms ~ 10ms sweep, normal
5ms ~ 1ms sweep, normal
Q45, D60, 61
Q43
5ms ~ .1ms sweep, normal
Q46, D62, 63
0.5ms ~ 0.1ms sweep, normal
50μs ~ 10μs sweep, normal
Q47, D64, 65
Q44
50μs ~ 10μs sweep, normal
Q48, D66, 67
5μs ~ 1μs sweep, normal
Q49, D68
0.5μs ~ 0.1μs sweep, normal
D69
0.05μs, 0.02μs sweep, normal
D70
END


DUAL SWEEP
B sweep, normal
YES
NO
(X74-1220)
Collector waveform of Q51, normal
Q50, 51, IC9b D71, 72
IC 9d "H"
IC8a IC9c, d, 10d
IC7b R signal, normal
IC8a, 9b,c.
BLANKING CONTROL
END

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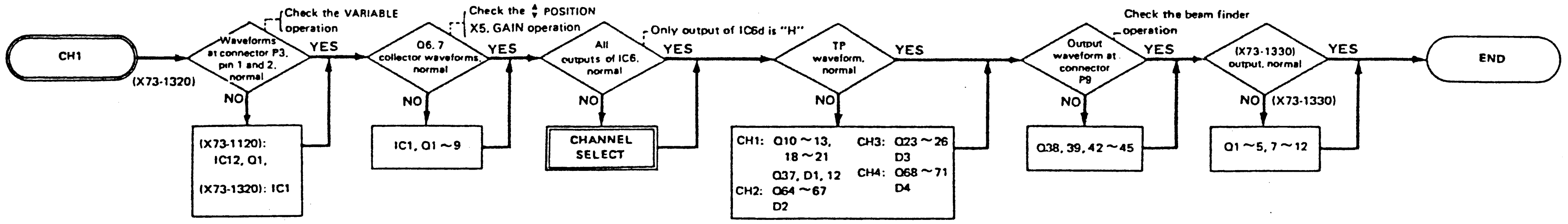
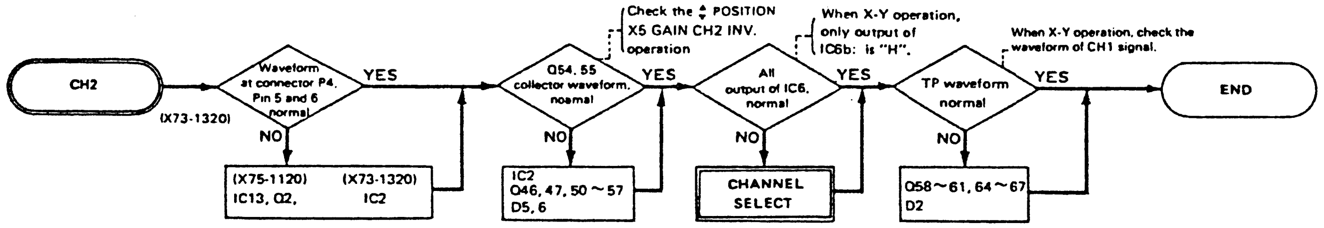
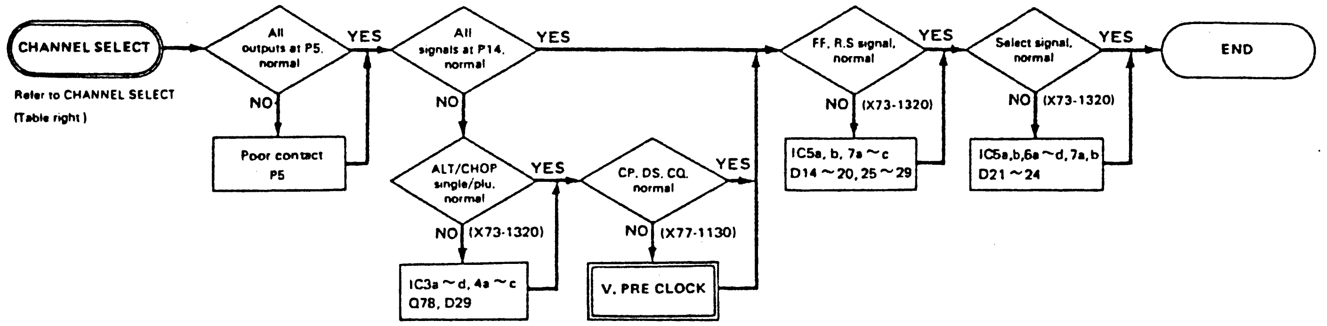
TROUBLESHOOTING


CH1
(X73-1320)
Check the VARIABLE operation
Waveforms at connector P3, pin 1 and 2, normal
YES
NO
(X73-1120): IC12, Q1, (X73-1320): IC1
Check the ⇕ POSITION X5, GAIN operation
Q6, 7 collector waveforms, normal
YES
NO
IC1, Q1 ~ 9
Only output of IC6d is "H"
All outputs of IC6, normal
YES
NO
CHANNEL SELECT
TP waveform, normal
YES
NO
CH1: Q10 ~ 13, 18 ~ 21 Q37, D1, 12
CH2: Q64 ~ 67 D2
CH3: Q23 ~ 26 D3
CH4: Q68 ~ 71 D4
Check the beam finder operation
Output waveform at connector P9
YES
NO
Q38, 39, 42 ~ 45
(X73-1330) output, normal
YES
NO (X73-1330)
Q1 ~ 5, 7 ~ 12
END


CH2
(X73-1320)
Waveform at connector P4, Pin 5 and 6 normal
YES
NO
(X75-1120) IC13, Q2,
(X73-1320) IC2
Check the ⇕ POSITION X5 GAIN CH2 INV. operation
Q54, 55 collector waveform, noamal
YES
NO
IC2 Q46, 47, 50 ~ 57 D5, 6
When X-Y operation, only output of IC6b: is "H".
All output of IC6, normal
YES
NO
CHANNEL SELECT
When X-Y operation, check the waveform of CH1 signal.
TP waveform normal
YES
NO
Q58 ~ 61, 64 ~ 67 D2
END


CHANNEL SELECT
Refer to CHANNEL SELECT (Table right)
All outputs at P5, normal
YES
NO
Poor contact P5
All signals at P14, normal
YES
NO
ALT/CHOP single/plu. normal
YES
NO (X73-1320)
IC3a ~ d, 4a ~ c Q78, D29
CP, DS, CQ. normal
YES
NO (X77-1130)
V. PRE CLOCK
FF, R.S signal, normal
YES
NO (X73-1320)
IC5a, b, 7a ~ c D14 ~ 20, 25 ~ 29
Select signal, normal
YES
NO (X73-1320)
IC5a,b,6a ~ d, 7a, b D21 ~ 24
END

CHANNEL SELECT

				MODE INPUT LOG OUTPUT (P5) signal					VERTICAL CLOCK (P14)					FLIP-FLOP PRESET, CLEAR signal			FLIP-FLOP OUTPUT signal				CHANNEL SELECT signal			
				CH1	CH2	DUAL	ADD	ALT	ALT/CHOP	Single/plu	CP	DS	CQ	R5b	S5b	R5a	Q5b	$\overline{\text{Q5b}}$	Q5a	$\overline{\text{Q5a}}$	CH1	CH2	CH3	CH4
SWEEP OPERATION	Except the DUAL SWEEP		CH1	L	H	H	H	H	L	L	L	L	X	L	H	L	L	H	L	H	H	L	L	L
			CH2	H	L	H	H	H	L	L	L	L	X	H	L	L	H	L	L	H	L	H	L	L
			ADD	H	H	H	L	H	L	L	L	L	X	L	L	L	H	H	L	H	H	H	L	L
		DUAL	ALT	H	H	L	H	L	L	H	⊓⊓⊓	⊓⊓⊓	L	H	H	L	TOGGLE		L	H	Fig1		L	L
			CHOP					H	H															
		QUAD	ALT			H		L	L							H	TOGGLE		TOGGLE		Fig2			
			CHOP					H	H															
	DUAL SWEEP	DUAL	ALT	H	H	L	H	L	L	H	⊓⊓⊓	⊓⊓⊓	H	L	L	L	H	H	L	H	Fig3		L	L
			CHOP					H	H															
		QUAD	ALT			H		L	L							H	H	H	TOGGLE		Fig4			
			CHOP					H	H															
X-Y operation				X	X	X	X	X	X	H	H	L	L	L	H	L	L	H	L	H	H	L	L	L

(Note) "X" H or L

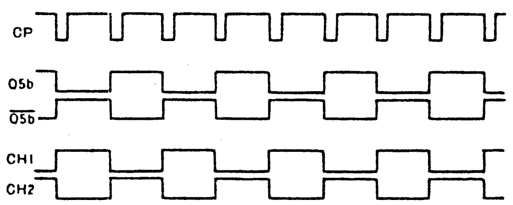

CP
Q5b
$\overline{\text{Q5b}}$
CH1
CH2

Fig. 1 (Synchronized with the CP signal regardless of the DS signal)

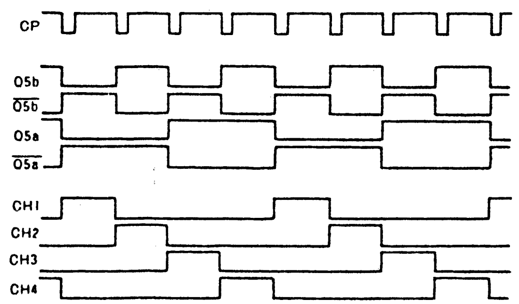

CP
Q5b
$\overline{\text{Q5b}}$
Q5a
$\overline{\text{Q5a}}$
CH1
CH2
CH3
CH4

Fig. 2 (Synchronized with the CP signal regardless of the DS signal)

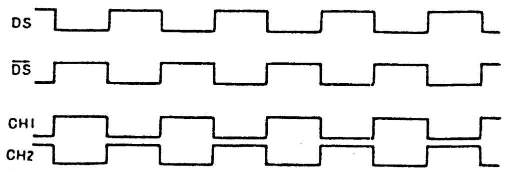

DS
$\overline{\text{DS}}$
CH1
CH2

Fig. 3 (Synchronized with the DS signal regardless of the CP signal)

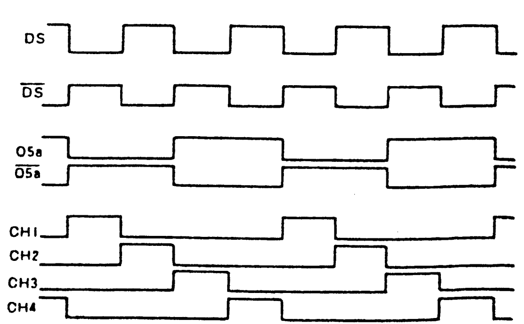

DS
$\overline{\text{DS}}$
Q5a
$\overline{\text{Q5a}}$
CH1
CH2
CH3
CH4

Fig. 4 (Synchronized with the DS signal regardless of the CP signal)

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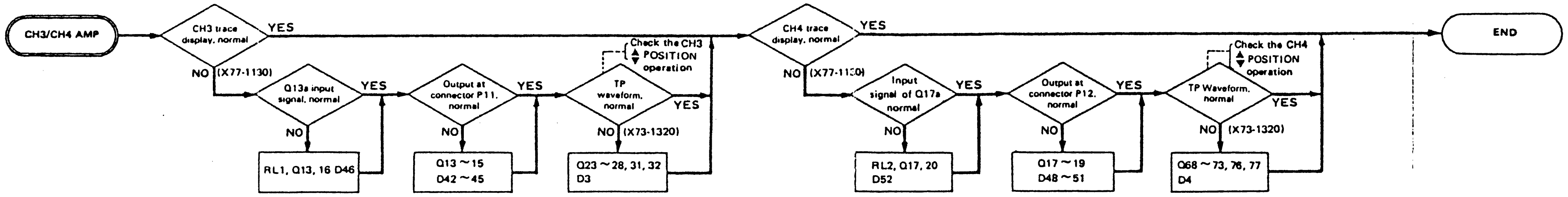
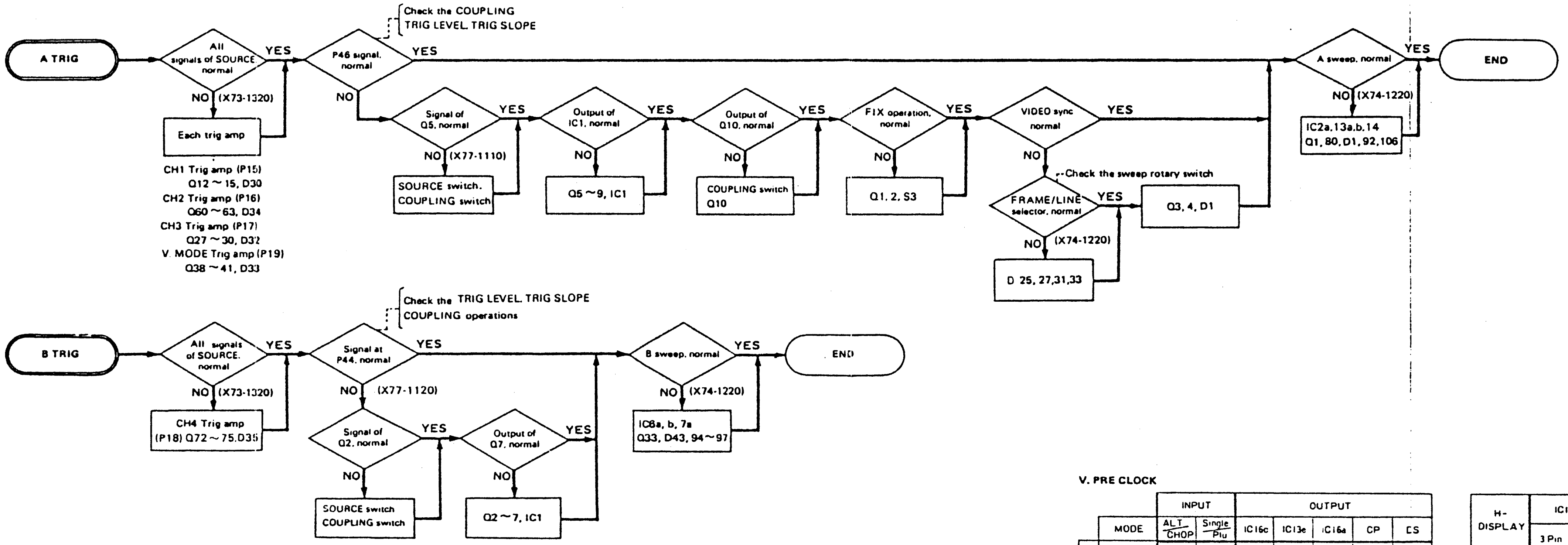
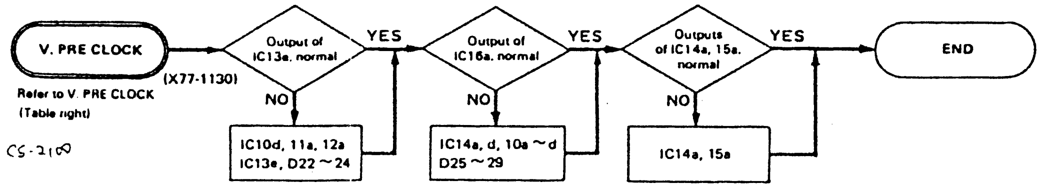
TROUBLESHOOTING


CH3/CH4 AMP
CH3 trace display, normal
YES
NO (X77-1130)
Q13a input signal, normal
YES
NO
RL1, Q13, 16 D46
Output at connector P11, normal
YES
NO
Q13 ~ 15
D42 ~ 45
Check the CH3 ▲▼ POSITION operation
TP waveform, normal
YES
NO (X73-1320)
Q23 ~ 28, 31, 32
D3
CH4 trace display, normal
YES
NO (X77-1130)
Input signal of Q17a normal
YES
NO
RL2, Q17, 20
D52
Output at connector P12, normal
YES
NO
Q17 ~ 19
D48 ~ 51
Check the CH4 ▲▼ POSITION operation
TP Waveform, normal
YES
NO (X73-1320)
Q68 ~ 73, 76, 77
D4
END


A TRIG
All signals of SOURCE normal
YES
NO (X73-1320)
Each trig amp
CH1 Trig amp (P15)
Q12 ~ 15, D30
CH2 Trig amp (P16)
Q60 ~ 63, D34
CH3 Trig amp (P17)
Q27 ~ 30, D32
V. MODE Trig amp (P19)
Q38 ~ 41, D33
Check the COUPLING
TRIG LEVEL. TRIG SLOPE
P46 signal, normal
YES
NO
Signal of Q5, normal
YES
NO (X77-1110)
SOURCE switch.
COUPLING switch
Output of IC1, normal
YES
NO
Q5 ~ 9, IC1
Output of Q10, normal
YES
NO
COUPLING switch
Q10
FIX operation, normal
YES
NO
Q1, 2, S3
VIDEO sync normal
YES
NO
Check the sweep rotary switch
FRAME/LINE selector, normal
YES
NO (X74-1220)
Q3, 4, D1
D 25, 27,31,33
A sweep, normal
YES
NO (X74-1220)
IC2a, 13a.b.14
Q1, 80, D1, 92, 106
END
B TRIG
All signals of SOURCE, normal
YES
NO (X73-1320)
CH4 Trig amp
(P18) Q72 ~ 75.D35
Check the TRIG LEVEL. TRIG SLOPE
COUPLING operations
Signal at P44, normal
YES
NO (X77-1120)
Signal of Q2, normal
YES
NO
SOURCE switch
COUPLING switch
Output of Q7, normal
YES
NO
Q2 ~ 7, IC1
B sweep, normal
YES
NO (X74-1220)
IC8a, b, 7a
Q33, D43, 94 ~ 97
END


V. PRE CLOCK
(X77-1130)
Refer to V. PRE CLOCK (Table right)
Output of IC13e, normal
YES
NO
IC10d, 11a, 12a
IC13e, D22 ~ 24
Output of IC16a, normal
YES
NO
IC14a, d, 10a ~ d
D25 ~ 29
Outputs of IC14a, 15a, normal
YES
NO
IC14a, 15a
END

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V. PRE CLOCK

			INPUT		OUTPUT				
		MODE	ALT / CHOP	Single / Plu	IC16c	IC13e	IC16a	CP	DS
SWEEP		CH1	L	L	H	Refer to the right table.	IC13e	L	L
		CH2	L	L	H			L	L
	DUAL	ALT	L	H	H			IC13e	Q11b
		CHOP	H		L		CHOP Osc	CHOP Pulse	
		ADD	L	L	H		IC13d	L	L
	QUAD	ALT	L	H	H		IC13d	IC13e	Q11b
		CHOP	H		L		CHOP Osc	CHOP Pulse	
X-Y operation			X	H	H		H	H	L

Each signal of IC16a, CP, DS vary by H. DISPLAY.

H-DISPLAY	IC12a		IC13e	CO	IC11b
	3 Pin	5 Pin	OUTPUT		O
A	L	H	QA signal	L	H
ALT	H	L	Divide by two of QA signal	L	Divide by two of QA signal
A·INT·B	L	H	QA signal	L	H
B DLY'D	H	H	QA signal	L	L
DUAL	L	L	Divide by two of QA signal	H	Divide by two of QA signal
X·Y	H	H	H	L	H

PARTS LIST

Unless otherwise specified, all resistors are ±5%, 1/8W and all capacitor's voltage ratings are 50WV.

The specifications and parts list and schematic diagram may be changed without notice owing to a technical innovation.

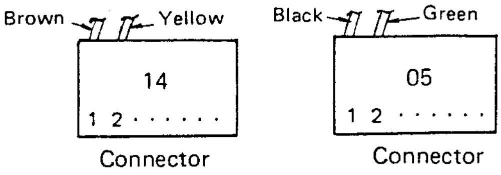
ABBREVIATIONS

Resistor	
RD	Carbon
RN	Metal film
RS	Metal film
RC	Solid
VR	Variable or Semi-fixed
Capacitor	
CC	Ceramic
CK	Ceramic
CE	Electrolytic
CM	Mica
CQ	Mylar
TC	Ceramic trimmer
Semiconductor	
TR	Transistor
FET	Field effect transistor

The part No. of each connector is stamped or color-coded. The color-coding is as follows.

Black	Brown	Red	Orange	Yellow	Green	Blue	Purple	Grey	White
0	1	2	3	4	5	6	7	8	9

[Example]



Each connector can be classified by the color of pin 1 and pin 2.

PARTS LIST

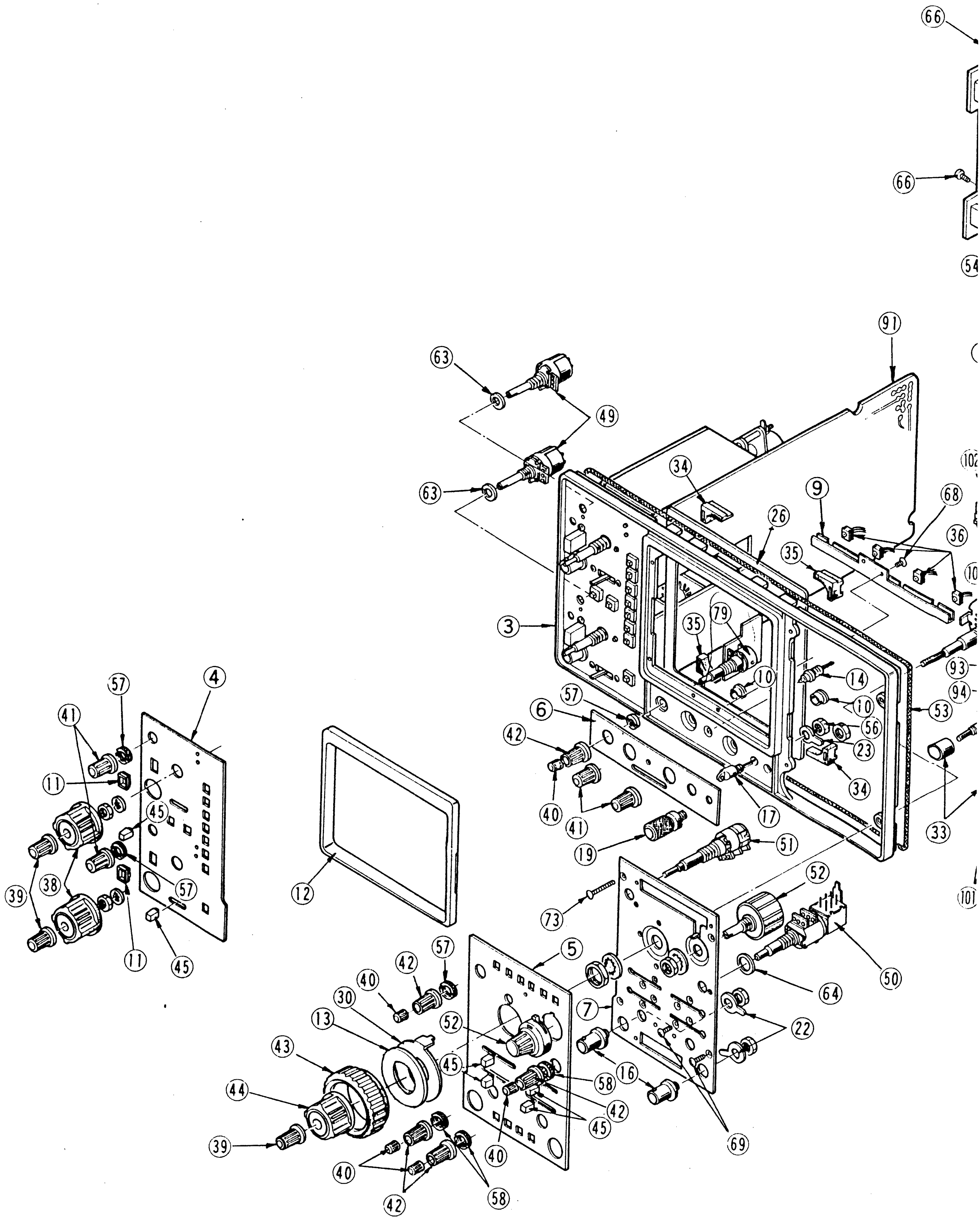
MAIN CHASSIS

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff.	
1-1		A13-0731-42	Frame		
1-2		A13-0732-12	Frame		
1-3		A20-2756-05	Die-casting panel		
1-4		A21-0882-04	Decorative panel		
1-5		A21-0883-04	Decorative panel		
1-6		A21-0884-04	Decorative panel		
1-7		A22-0817-13	Sub panel		
1-8		A23-1627-02	Rear panel		
1-9		A33-0501-14	Reflector		
1-10		B07-0701-04	Push escutcheon		
1-11		B07-0706-04	Push escutcheon		
1-12		B19-0713-03	Filter		
1-13		B20-0919-04	Floating core		
1-14		B30-0903-15	LED		
1-15		E03-0201-05	Power connector		
1-16		E04-0251-05	BNC jack		
1-17		E21-0654-04	CAL terminal		
1-18		E21-0659-15	Coil CAL		
1-19		E21-0657-04	GND terminal		
1-20		E29-0504-05	Teflon terminal		
1-21		E23-0015-04	Terminal lug		
1-22		E23-0513-05	Earth lug		
1-23		E23-0520-05	Earth lug		
1-24		F05-1224-05	Fuse 1.2A		
1-25		F15-0138-04	Felt		
1-26		F15-0716-14	Spacer		
1-27		F20-0621-04	Insulator plate		
1-28		J13-0038-05	Fuse holder		
1-29		J19-1624-04	Stopper		
1-30		J21-2927-04	Ring-antirun		
1-31		J21-2928-04	Bracket (For D.L.)		
1-32		J29-0505-04	Retainer clamp		
1-33		J39-0506-04	Spacer		
1-34		J42-0512-04	Mounting rubber (For CRT)		
1-35		J42-0513-04	Mounting rubber (For CRT)		
1-36		J42-0514-04	Mounting rubber (For lamp)		
1-37		J61-0511-05	Wire suddle		
1-38		K21-0819-03	Knob		
1-39		K21-0821-14	Knob		
1-40		K21-0831-24	Knob		
1-41		K21-0832-14	Knob		
1-42		K21-0833-14	Knob		
1-43		K21-0837-14	Knob		
1-44		K21-0838-03	Knob		
1-45		K27-0502-04	Lever knob		
1-46		L76-0104-05	Delay line		
1-47	S29	S31-2004-05	Slide switch		
1-48			Power thermister 4W-25V		
1-49	VR1	R01-1507-05	Variable resistor 3 kΩB		
	VR2	R01-1507-05	Variable resistor 3 kΩB		
1-50	VR4a	R06-2502-05	Variable resistor 5 kΩB		
	VR4b	R06-2502-05	Variable resistor 5 kΩB		
1-51	VR3a	R23-2501-05	Variable resistor 5 kΩB		
	VR3b	R23-2501-05	Variable resistor 5 kΩB		
1-52	VR5	R29-0504-05	Potentio meter 1 kΩB		
1-53		002-0006-05	Shield gasket		
1-54		N08-0609-04	Post (Hex)		
1-55		N10-2030-41	Nut (Hex) M3		
1-56		N10-2060-46	Nut (Hex) M6		
1-57		N14-0602-34	Nut		
1-58		N14-0609-04	Nut		
1-59		N16-0026-46	Lockwasher (For M2.6)		
1-60		N16-0030-46	Lockwasher (For M3)		
1-61		N17-1030-41	Lockwasher (For M3) (For CASE X 4)		
1-62		N19-0191-05	Washer nonmetal		
1-63		N19-0702-04	Flat washer		

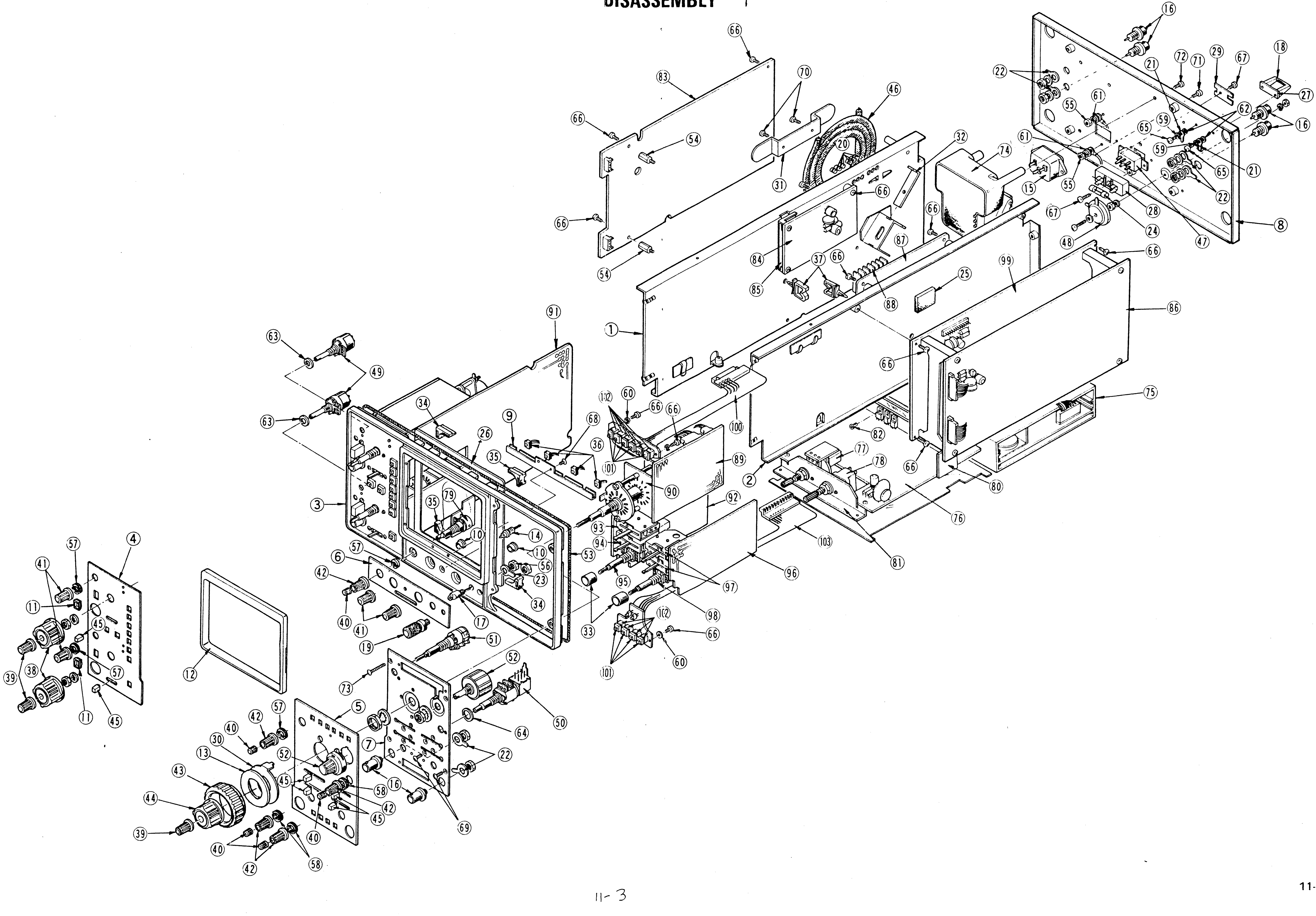
PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff.	
1-64		N19-0704-04	Flat washer		
1-65		N30-2608-41	Pan-head screw M2.6 × 8		
1-66		N30-3006-46	Pan-head screw M3 × 6		
1-67		N30-3008-41	Pan-head screw M3 × 8 (FOR CASE)		
1-68		N32-2606-46	Flat-head screw M2.6 × 6		
1-69		N32-3006-46	Flat-head screw M3 × 6		
1-70		N89-3006-46	Screw (Tapping) 3 × 6		
1-71		N89-3008-46	Screw (Tapping) 3 × 8		
1-72		N89-3010-46	Screw (Tapping) 3 × 10		
1-73		N09-0707-05	Flat-head screw (Tapping) (3 × 18)		
1-74		W02-0402-05	High voltage block		
1-75		W02-0405-05	Switching power block	Note 1	
1-76		X08-1310-00	Power blanking unit		
		J25-2909-12	Printed circuit board		
1-77		R03-3502-15	Variable resistor 10 kΩB		
1-78		R05-8001-05	Variable resistor 3 MΩB		
1-79		R23-1501-05	Variable resistor 1 kΩB		
1-80		F02-0503-04	Heat sink		
1-81		J21-2930-04	Bracket (For VR)		
1-82		N09-0078-05	Screw M3 × 6 (Plastic)		
1-83		X73-1320-00	Vertical pre amp unit		
		J25-2909-12	Printed circuit board		
1-84		X73-1330-00	Vertical output unit		
		J25-2905-12	Printed circuit board		
1-85		F02-0501-04	Heat sink		
1-86		X74-1220-00	Trig sweep unit		
		J25-2913-12	Printed circuit board		
1-87		X74-1230-02	Horizontal output amp unit		
		J25-2913-12	Printed circuit board		
1-88		F01-0827-04	Heat sink		
1-89		X74-1250-00	Sweep rotary unit		
		J25-2919-12	Printed circuit board		
1-90		S02-2501-05	Rotaly switch		
1-91		X75-1120-00	Vertical ATT unit		
		J25-2919-12	Printed circuit board		
1-92		X77-1110-00	A trig switch unit		
		J25-2909-12	Printed circuit board		
1-93		S33-2501-05	Lever switch		
1-94		S32-4008-05	Lever switch		
1-95		R01-2510-05	Variable resistor 5 kΩB		
1-96		X77-1120-00	B trig switch unit		
		J25-2919-12	Printed circuit board		
1-97		S37-2005-05	Lever switch		
1-98		R01-2511-05	Variable resistor 5 kΩB		
1-99		X77-1130-00	Horizontal mode control unit		
		J25-2905-12	Printed circuit board		
1-100		J25-2900-03	Printed circuit board		
1-101		K27-0524-04	Push knob		
1-102	S1	S40-1504-05	Tact switch		
	S3	S40-1504-05	Tact switch		
	S4	S40-1504-05	Tact switch		
	S5	S40-1504-05	Tact switch		
	S6	S40-1504-05	Tact switch		
	S7	S40-1504-05	Tact switch		
	S8	S40-1504-05	Tact switch		
	S9	S40-1504-05	Tact switch		
	S10	S40-1504-05	Tact switch		
	S11	S40-1504-05	Tact switch		
	S12	S40-1504-05	Tact switch		
	S13	S40-1504-05	Tact switch		
	S14	S40-1504-05	Tact switch		
	S15	S40-1504-05	Tact switch		
	S16	S40-1504-05	Tact switch		
	S17	S40-1504-05	Tact switch		
	S18	S40-1504-05	Tact switch		
	S19	S40-1504-05	Tact switch		
1-103		J25-2902-03	Printed circuit board		

Note 1:
When replacing W02-0405-05 with W02-0405-15 add C10 and change C4 and C5.



DISASSEMBLY 1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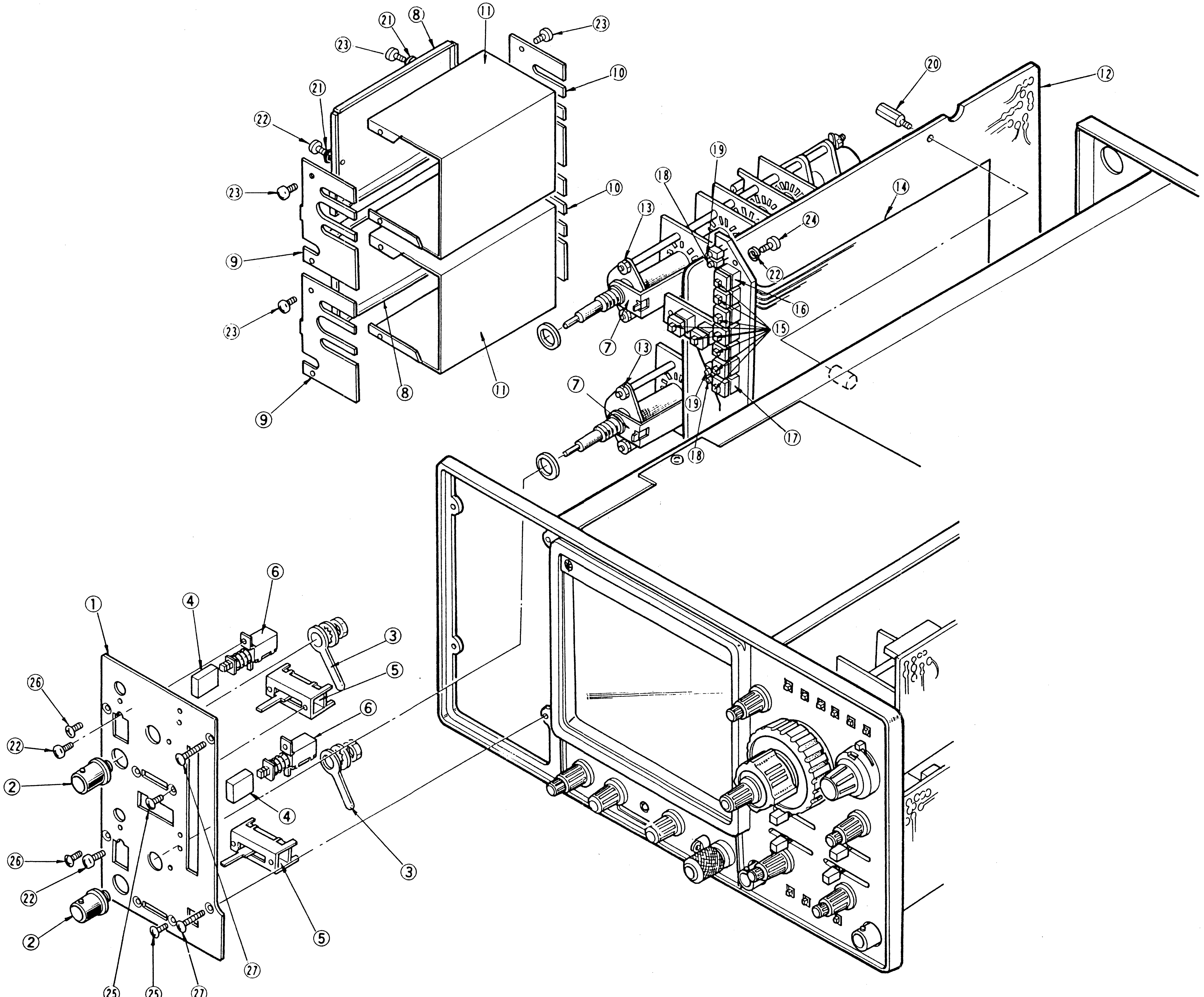
DISASSEMBLY 2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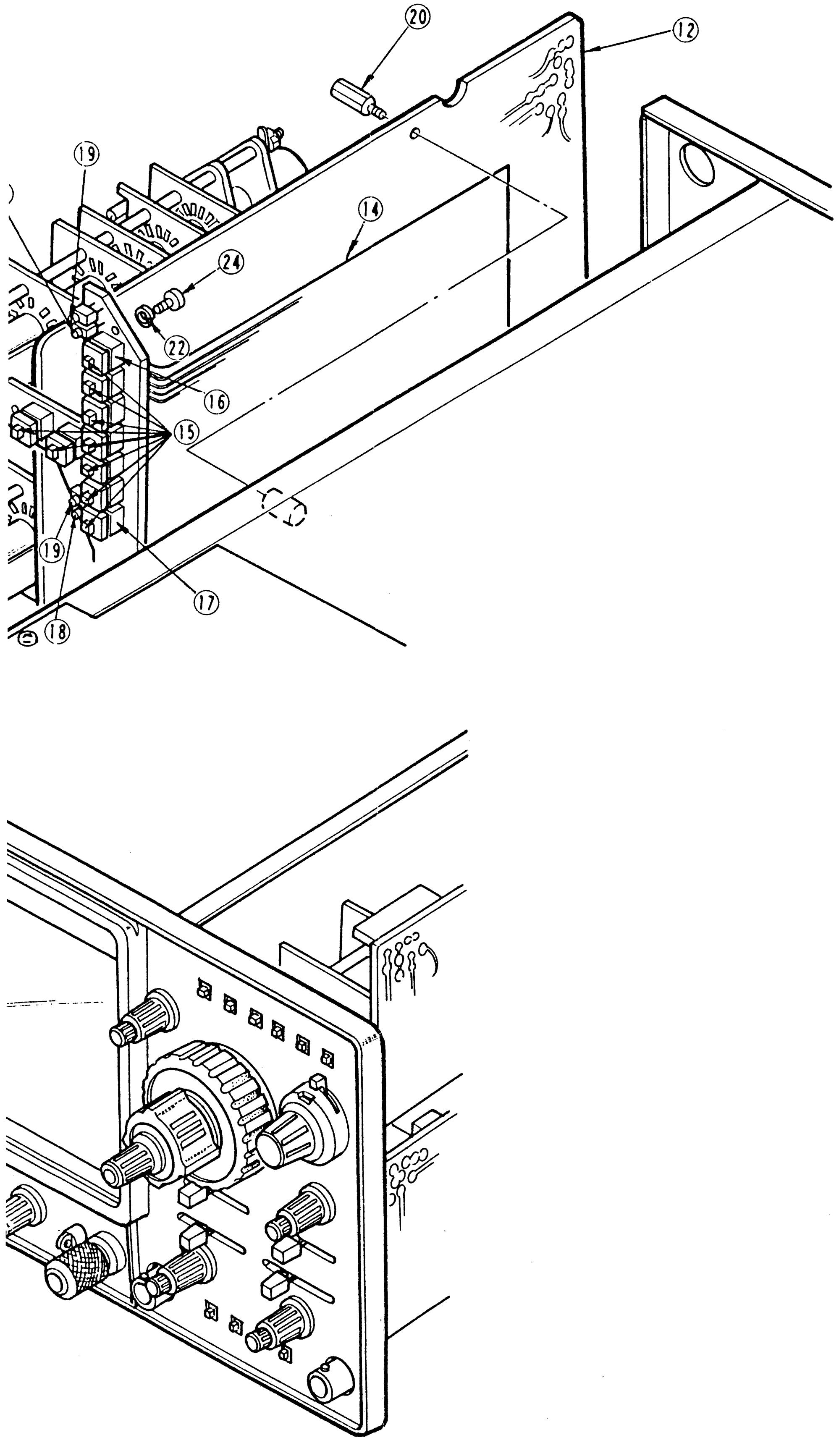
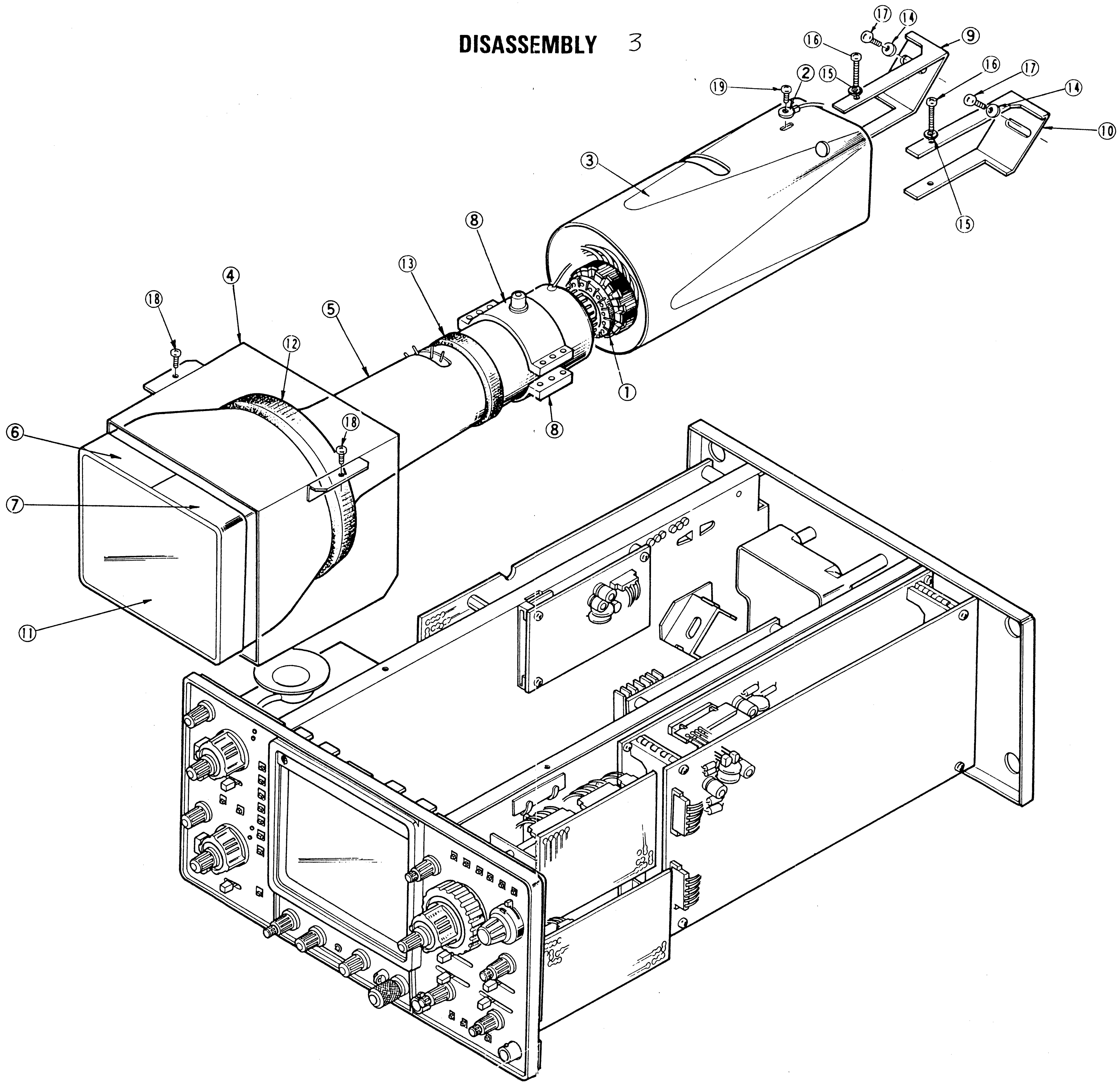


PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff.	
2-1		A22-0816-13	Sub panel		
2-2		E04-0251-05	BNC jack		
2-3		E23-0519-04	Earth lug		
2-4		K27-0504-04	Push knob		
2-5	S25	S31-2506-05	Slide switch		
	S26	S31-2506-05	Slide switch		
2-6	S23	S40-2403-05	Push switch		
	S24	S40-2403-05	Push switch		
2-7		E23-0521-04	Earth terminal		
2-8		F11-0961-04	Shield case		
2-9		F11-0964-04	Shield case		
2-10		F11-0965-04	Shield case		
2-11		F11-0966-04	Shield case		
2-12		X75-1120-00	Vertical ATT unit		
		J25-2919-12	Printed circuit board		
2-13		S01-4501-05	Rotary switch		
2-14		J25-2898-03	Printed circuit board		
2-15		K27-0524-04	Push knob		
2-16	S1	S40-1504-05	Tact switch		
	S2	S40-1504-05	Tact switch		
	S3	S40-1504-05	Tact switch		
	S4	S40-1504-05	Tact switch		
	S5	S40-1504-05	Tact switch		
	S6	S40-1504-05	Tact switch		
	S7	S40-1504-05	Tact switch		
	S8	S40-1504-05	Tact switch		
	S9	S40-1504-05	Tact switch		
	S10	S40-1504-05	Tact switch		
	S11	S40-1504-05	Tact switch		
	S12	S40-1504-05	Tact switch		
	S13	S40-1504-05	Tact switch		
	S14	S40-1504-05	Tact switch		
	S15	S40-1504-05	Tact switch		
	S16	S40-1504-05	Tact switch		
	S17	S40-1504-05	Tact switch		
	S18	S40-1504-05	Tact switch		
	S19	S40-1504-05	Tact switch		
2-17	S20	S40-1505-05	Tact switch		
2-18		K-14LN222RP	LED		
2-19		K-14LN322GP	LED		
2-20		N08-0609-04	Post (Hex)		
2-21		N16-0026-46	Lockwasher		
2-22		N16-0030-46	Lockwasher		
2-23		N30-2604-46	Pan-head screw M2.6 × 4		
2-24		N30-3006-46	Pan-head screw M3 × 6		
2-25		N32-2004-46	Flat-head screw M2 × 4		
2-26		N32-3006-46	Flat-head screw M3 × 6		
2-27		N09-0707-05	Flat-head screw (Tapping) 3 × 18		

DISASSEMBLY 3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DISASSEMBLY / PARTS LIST 4

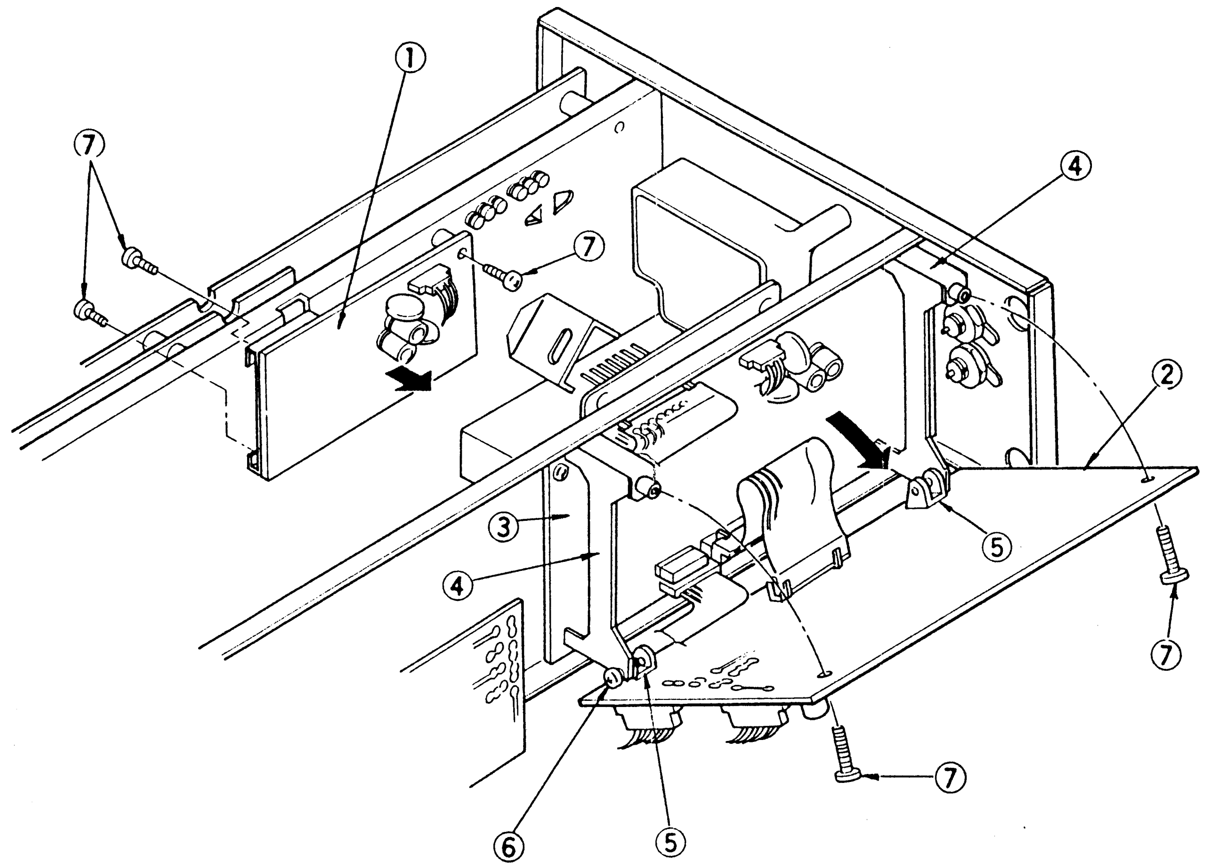


Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff.	
4-1		X73-1330-00	Vertical output unit		
		J25-2905-12	Printed circuit board		
4-2		X74-1220-00	Trig sweep unit		
		J25-2913-12	Printed circuit board		
4-3		X77-1130-00	Horizontal mode control unit		
		J25-2905-12	Printed circuit board		
4-4		J21-2904-14	Bracket (For P.C.B.)		
4-5		J21-2905-04	Bracket (For P.C.B.)		
4-6		N09-0402-05	Screw		
4-7		N30-3006-46	Pan-head screw M3 × 6		

DISASSEMBLY / PARTS LIST 5

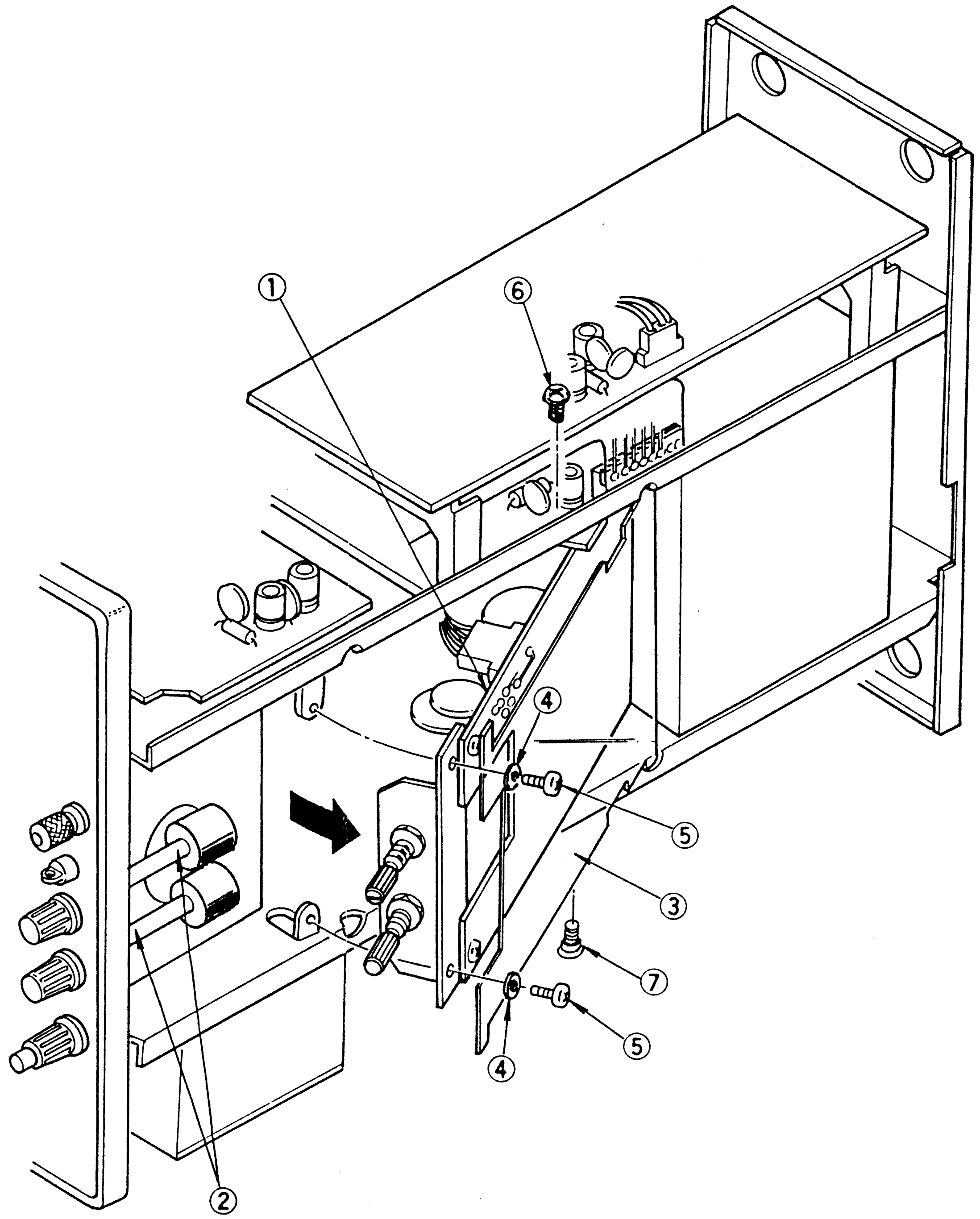


Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff.	
5-1		X68-1310-00	Power blanking unit		
		J25-2909-12	Printed circuit board		
5-2		D21-0903-04	Extension shaft		
5-3		F20-0624-04	Insulator		
5-4		N16-0030-46	Lockwasher		
5-5		N30-3006-46	Pan-head screw M3 × 8		
5-6		N89-3006-46	Screw (Tapping) 3 × 6		
5-7		N09-0402-05	Screw		

PACKING/PARTS LIST 7

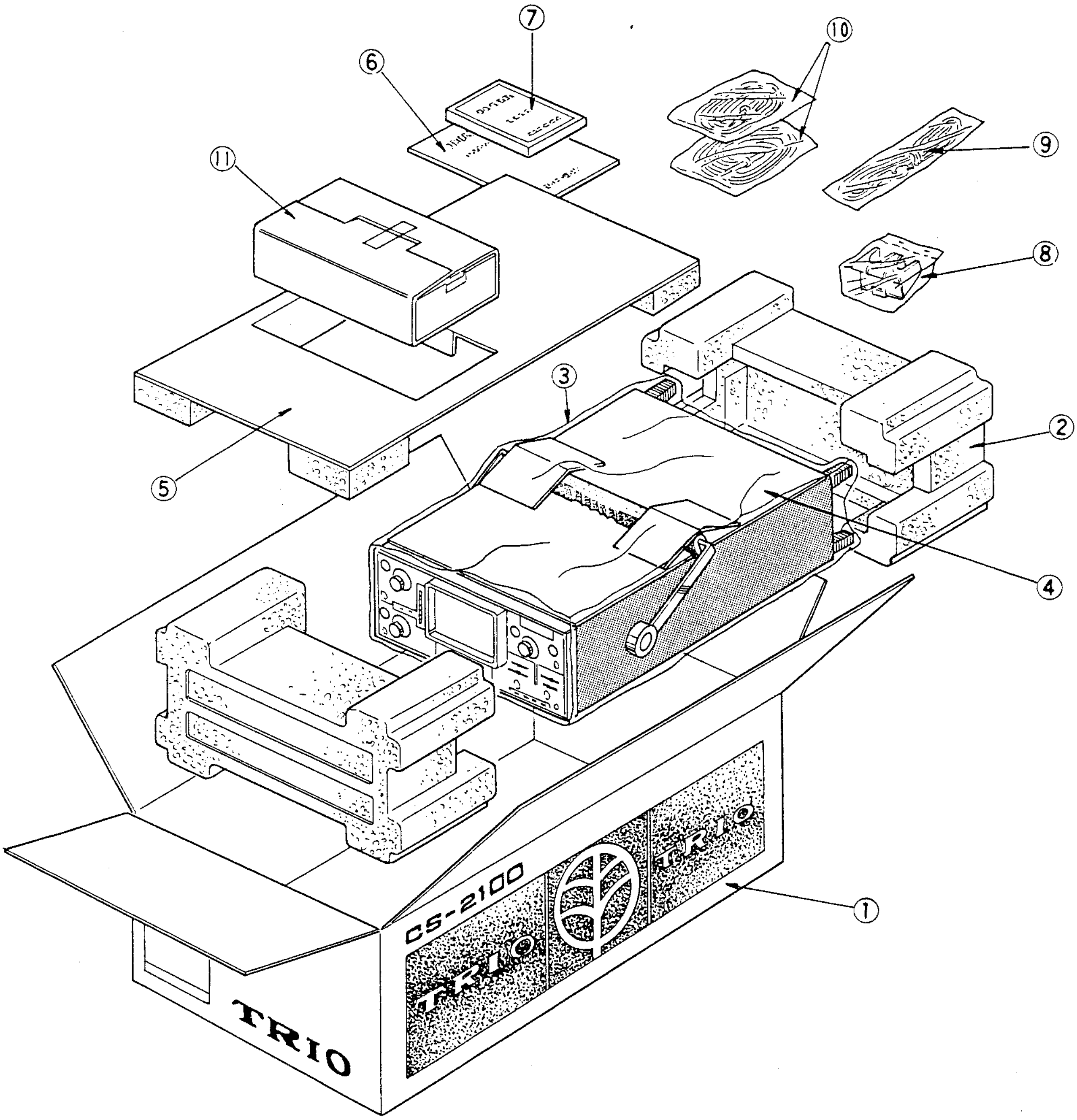


Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff.	
7-1		H01-2922-04	Carton box		
7-2		H10-2812-02	Pad (Formed styrene)		
7-3		H20-1713-14	Polyethylene bag		
7-4		H12-0531-04	Protective cover		
7-5		H12-0536-03	Pad (Carton)		
7-6		B50-2932-00	Instruction manual		
7-7		B50-2942-00	Instruction hand book		
7-8		J21-2903-03	Probe holder		
7-9		E30-1818-05	Power cord (JIS)		
		E30-1819-05	Power cord (CEE)		
		E30-1821-05	Power cord (SAA)		
7-10		Y87-1250-00	Probe (PC-29)		
7-11		H12-0535-03	Pad (Carton)		

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff
			Thermister 4W-25V	
	R1	RN14BK2H50R0F	Metal film resistor, 50Ω±1%, 1/2W	
	R2	RN14BK2H50R0F	Metal film resistor, 50Ω±1%, 1/2W	
	R3	RD14BB2E105J	Carbon resistor, 1MΩ±5%, 1/4W	
	R4	RD14BB2E105J	Carbon resistor, 1MΩ±5%, 1/4W	
	R5	RD14BB2E220J	Carbon resistor, 22Ω±5%, 1/4W	
	R6	RD14BB2E220J	Carbon resistor, 22Ω±5%, 1/4W	
	R7	RD14BB2E220J	Carbon resistor, 22Ω±5%, 1/4W	
	R8	RD14BB2E220J	Carbon resistor, 22Ω±5%, 1/4W	
	C1	C91-0501-05	Metalized film capacitor, 0.047μF, 630WV	
	C2	C91-0501-05	Metalized film capacitor, 0.047μF, 630WV	
	C3	C90-0298-05	Semi-conductor ceramic capacitor, 0.1μF, 12WV	
	C4	C91-0502-05	Metalized film capacitor, 0.01μF, 630WV	
	C5	C91-0502-05	Metalized film capacitor, 0.01μF, 630WV	
	C6	CC45CH1H101J	Ceramic capacitor, 100pF, ±5%	
	C7	CC45CH1H030C	Ceramic capacitor, 3pF, ±0.25pF	
		B40-2765-04	Name plate	
		B41-0730-04	Caution sheet	
		B42-1835-04	Voltage indication sheet	
		B42-1836-04	Voltage indication sheet	
	J7	E31-0748-05	Leadwire with connector	
	J8	E31-0749-05	Leadwire with connector	
	J9	E31-0750-05	Leadwire with connector	
	J10	E31-0751-05	Leadwire with connector	
	J11	E31-0797-05	Leadwire with connector	
	J12	E31-0797-05	Leadwire with connector	
	J31	E31-0752-05	Leadwire with connector	
	J32	E31-0753-05	Leadwire with connector	
	J33	E31-0754-05	Leadwire with connector	
	J40	E31-0757-05	Leadwire with connector	
	J41	E31-0758-05	Leadwire with connector	
	J51	E31-0755-05	Leadwire with connector	
	J56	E31-0790-05	Leaduire with connector	
	J57	E31-0799-05	Leadwire with connector	
		E31-0756-05	Leadwire with connector	
		E31-0564-05	Leadwire with connector	
		E31-0759-05	Wire harness	
		E40-0711-05	Pin connector 7P	
		E40-1811-05	Pin connector 18P	
		E40-1216-05	Pin connector 12P	
		E40-1516-05	Pin connector 15P	
		E40-1816-05	Pin connector 18P	
		F11-0963-03	Shield case	
		L92-0103-05	Ferrite core	
		J61-0501-05	Supporter (For P.C.B.)	

PARTS LIST

VERTICAL ATTENUATOR UNIT X75-1120-00

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff.	
	R1	RD14BB2E150J	RD 15Ω ±5% 1/4W		
	R2	RD14BB2B220J	RD 22Ω		
	R3	RD14BB2E220J	RD 22Ω ±5% 1/4W		
A-3	R4	RN14BK2H5003F	RN 500kΩ ±1% 1/2W		
B-3	R5	RN14BK2H1004F	RN 1MΩ ±1% 1/2W		
A-3	R6	RD14BB2B820J	RD 82Ω		
A-3	R7	RN14BK2H7503F	RN 750kΩ ±1% 1/2W		
A-3	R8	R92-0795-05	RD 333kΩ ±1% 1/2W		
A-3	R9	RD14BB2B201J	RD 200Ω		
A-2	R10	RN14BK2H9003F	RN 900kΩ ±1% 1/2W		
A-2	R11	RN14BK2E1113F	RN 111kΩ ±1% 1/4W		
A-2	R12	RD14BB2B102J	RD 1kΩ		
A-2	R13	RD14BB2B681J	RD 680Ω		
A-2	R14	RD14BB2B220J	RD 22Ω		
B-3	R15	RN14BK2H9003F	RN 900kΩ ±1% 1/2W		
B-2	R16	RN14BK2E1113F	RN 111kΩ ±1% 1/4W		
B-3	R17	RD14BB2B150J	RD 15Ω		
B-3	R18	RD14BB2B560J	RD 56Ω		
B-2	R19	RD14BB2B820J	RD 82Ω		
B-3	R20	RN14BK2H9903F	RN 990kΩ ±1% 1/2W		
B-3	R21	RN14BK2E1012F	RN 10.1kΩ ±1% 1/4W		
B-3	R22	RD14BB2B100J	RD 10Ω		
B-3	R23	RD14BB2B471J	RD 470Ω		
B-3	R24	RD14BB2B180J	RD 18Ω		
B-3	R25	RD14BB2B621J	RD 620Ω		
B-3	R26	RN14BK2H1004F	RN 1MΩ ±1% 1/2W		
B-3	R27	RD14BB2E104J	RD 100kΩ ±5% 1/4W		
C-2	R28	RN14BK2B2001F	RN 2kΩ ±1% 1/8W		
C-2	R29	RN14BK2B2001F	RN 2kΩ ±1% 1/8W		
C-2	R30	RD14BB2B220J	RD 22Ω		
C-3	R31	RD14BB2B271J	RD 270Ω		
C-3	R32	RN14BK2B7500F	RN 750Ω ±1% 1/8W		
C-2	R33	RN14BK2B7500F	RN 750Ω ±1% 1/8W		
C-3	R34	RN14BK2B8200F	RN 820Ω ±1% 1/8W		
C-3	R35	RN14BK2B3300F	RN 330Ω ±1% 1/8W		
	R36	No use			
	R37	No use			
	R38	No use			
	R39	No use			
	R40	No use			
	R41	No use			
	R42	RD14BB2B221J	RD 220Ω		
	R43	RD14BB2E150J	RD 15Ω ±5% 1/4W		
	R44	RD14BB2B220J	RD 22Ω		
	R45	RD14BB2E470J	RD 47Ω ±5% 1/4W		
A-1	R46	RN14BK2H5003F	RN 500kΩ ±1% 1/2W		
B-2	R47	RN14BK2H1004F	RN 1MΩ ±1% 1/2W		
A-1	R48	RD14BB2B820J	RD 82Ω		
A-2	R49	RN14BK2H7503F	RN 750kΩ ±1% 1/2W		
A-2	R50	R92-0795-05	RD 333kΩ ±1% 1/2W		
A-1	R51	RD14BB2B181J	RD 180Ω		
A-1	R52	RN14BK2H9003F	RN 900kΩ ±1% 1/2W		
A-1	R53	RN14BK2E1113F	RN 111kΩ ±1% 1/4W		
A-1	R54	RD14BB2B102J	RD 1kΩ		
A-1	R55	RD14BB2B681J	RD 680Ω		
A-1	R56	RD14BB2B220J	RD 22Ω		
B-1	R57	RN14BK2H9003F	RN 900kΩ ±1% 1/2W		
B-1	R58	RN14BK2E1113F	RN 111kΩ ±1% 1/4W		
B-1	R59	RD14BB2B150J	RD 15Ω		
B-1	R60	RD14BB2B560J	RD 56Ω		
B-1	R61	RD14BB2B111J	RD 110Ω		
B-1	R62	RN14BK2H9903F	RN 990kΩ ±1% 1/2W		
B-2	R63	RN14BK2E1012F	RN 10.1kΩ ±1% 1/4W		
B-2	R64	RD14BB2B100J	RD 10Ω		

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description				Serial No. Eff.	
B-1	R65	RD14BB2B471J	RD	470Ω				
B-2	R66	RD14BB2B360J	RD	36Ω				
B-2	R67	RD14BB2B821J	RD	820Ω				
B-1	R68	RN14BK2H1004F	RN	1MΩ	±1%	1/2W		
B-1	R69	RD14BB2E104J	RD	100kΩ	±4%	1/4W		
C-2	R70	RN14BK2B2001F	RN	2kΩ	±1%	1/8W		
C-2	R71	RN14BK2B2001F	RN	2kΩ	±1%	1/8W		
C-2	R72	RD14BB2B220J	RD	22Ω				
C-1	R73	RD14BB2B271J	RD	270Ω				
C-1	R74	RN14BK2B7500F	RN	750Ω	±1%	1/8W		
C-1	R75	RN14BK2B7500F	RN	750Ω	±1%	1/8W		
C-1	R76	RN14BK2B8200F	RN	820Ω	±1%	1/8W		
C-1	R77	RN14BK2B3300F	RN	330Ω	±1%	1/8W		
	R78	No use						
	R79	No use						
	R80	No use						
	R81	No use						
	R82	No use						
	R83	No use						
C-1	R84	RD14BB2B221J	RD	220Ω				
D-3	R85	RD14BB2B224J	RD	220kΩ				
D-3	R86	RD14BB2B224J	RD	220kΩ				
D-3	R87	RD14BB2B224J	RD	220kΩ				
D-3	R88	RD14BB2B224J	RD	220kΩ				
D-3	R89	RD14BB2B224J	RD	220kΩ				
D-3	R90	RD14BB2B224J	RD	220kΩ				
D-3	R91	RD14BB2B224J	RD	220kΩ				
D-2	R92	RD14BB2B224J	RD	220kΩ				
D-2	R93	RD14BB2B224J	RD	220kΩ				
D-3	R94	RD14BB2B824J	RD	820kΩ				
D-3	R95	RD14BB2B824J	RD	820kΩ				
D-3	R96	RD14BB2B824J	RD	820kΩ				
D-3	R97	RD14BB2B824J	RD	820kΩ				
D-3	R98	RD14BB2B824J	RD	820kΩ				
D-3	R99	RD14BB2B824J	RD	820kΩ				
D-3	R100	RD14BB2B824J	RD	820kΩ				
D-1	R101	RD14BB2B824J	RD	820kΩ				
D-2	R102	RD14BB2B824J	RD	820kΩ				
E-2	R103	RD14BB2B824J	RD	820kΩ				
E-2	R104	RD14BB2B824J	RD	820kΩ				
E-2	R105	RD14BB2B274J	RD	270kΩ				
E-2	R106	RD14BB2B274J	RD	270kΩ				
E-2	R107	RD14BB2B274J	RD	270kΩ				
E-2	R108	RD14BB2B473J	RD	47kΩ				
E-2	R109	RD14BB2B473J	RD	47kΩ				
D-2	R110	RD14BB2B473J	RD	47kΩ				
D-1	R111	RD14BB2B393J	RD	39kΩ				
D-3	R112	RD14BB2B391J	RD	390Ω				
D-3	R113	RD14BB2B391J	RD	390Ω				
D-3	R114	RD14BB2B391J	RD	390Ω				
D-3	R115	RD14BB2B391J	RD	390Ω				
D-3	R116	RD14BB2B391J	RD	390Ω				
D-3	R117	RD14BB2B391J	RD	390Ω				
D-3	R118	RD14BB2B391J	RD	390Ω				
D-1	R119	RD14BB2B391J	RD	390Ω				
D-1	R120	RD14BB2B391J	RD	390Ω				
D-3	R121	RD14BB2B391J	RD	390Ω				
D-1	R122	RD14BB2B391J	RD	390Ω				
D-2	R123	RD14BB2B100J	RD	10Ω				
	R124	RD14BB2B824J	RD	820kΩ				
	R125	R92-0799-05	RD	6.8MΩ		1/4W		
	R126	No use						
	R127	RD14BB2B824J	RD	820kΩ				
	R128	R92-0799-05	RD	6.8MΩ		1/4W		
	R129	RD14BB2B153J	RD	15kΩ				
	R130	RD14BB2B824J	RD	820kΩ				

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff.	
	R131	RD14BB2B824J	RD 820kΩ		
	R132	RD14BB2B220J	RD 22Ω		
	R133	RD14BB2B220J	RD 22Ω		
	R134	RD14BB2B334J	RD 330kΩ		
	R135	R92-0799-05	RD 6.8MΩ 1/4W		
	R136	R92-0799-05	RD 6.8MΩ 1/4W		
	R137	R92-0799-05	RD 6.8MΩ 1/4W		
	R138	R92-0799-05	RD 6.8MΩ 1/4W		
	R139	RD14BB2B101J	RD 100Ω		
	R140	RD14BB2B101J	RD 100Ω		
C-2	VR1	R12-0530-05	VR 200Ω B		
C-2	VR2	R12-0530-05	VR 200Ω B		
C-3	VR3		1kΩ B attached S3		
C-1	VR4		1kΩ B attached S4		
	C1	CC45CH1H470J	CC 47pF ±5%		
	C2	CC45CH1H470J	CC 47pF ±5%		
	C3	CC45CH1H470J	CC 47pF ±5%		
A-2	C4	CM93BD2A100D	CM 10pF ±0.5pF 100WV		
B-2	C5	CM93BD2A100D	CM 10pF ±0.5pF 100WV		
B-3	C6	CM93BD2A221J	CM 220pF ±5% 100WV		
	C7	No use			
B-3	C8	C91-0502-05	Metalized film 0.01µF 630WV		
C-3	C9	CK45D1H103M	CK 0.01µF ±20%		
B-2	C10	CK45D1H103M	CK 0.01µF ±20%		
B-2	C11	CE04W1C330M	CE 33µF 16WV		
C-3	C12	CK45D1H103M	CK 0.01µF ±20%		
C-2	C13	CK45D1H103M	CK 0.01µF ±20%		
C-2	C14	CE04W1C330M	CE 33µF 16WV		
C-2	C15	CK45D1H103M	CK 0.01µF ±20%		
C-2	C16	CE04W1C330M	CE 33µF 16WV		
C-3	C17	CC45CH1H100D	CC 10pF ±0.5pF		
	C18	CC45CH1H470J	CC 47pF ±5%		
	C19	CC45CH1H470J	CC 47pF ±5%		
	C20	No use			
A-1	C21	CM93BD2A100D	CM 10pF ±0.5pF 100WV		
B-1	C22	CM93BD2A100D	CM 10pF ±0.5pF 100WV		
B-2	C23	CM93BD2A221J	CM 220pF ±5% 100WV		
B-2	C24	CC45CH1H010C	CC 1pF ±0.25pF		
B-1	C25	C91-0502-05	Metalized film 0.01µF 630WV		
C1	C26	CK45D1H103M	CK 0.01µF ±20%		
B-2	C27	CK45D1H103M	CK 0.01µF ±20%		
B-2	C28	CE04W1C330M	CE 33µF 16WV		
C-1	C29	CK45D1H103M	CK 0.01µF ±20%		
C-2	C30	CK45D1H103M	CK 0.01µF ±20%		
C-2	C31	CE04W1C330M	CE 33µF 16WV		
C-2	C32	CK45D1H103M	CK 0.01µF ±20%		
C-2	C33	CE04W1C330M	CE 33µF 16WV		
C-2	C34	CK45D1H103M	CK 0.01µF ±20%		
C-1	C35	CC45CH1H100D	CC 10pF ±0.5pF		
D-3	C36	CC45CH1H101J	CC 100pF ±5%		
D-3	C37	CC45CH1H101J	CC 100pF ±5%		
D-3	C38	CC45CH1H101J	CC 100pF ±5%		
D-3	C39	CC45CH1H101J	CC 100pF ±5%		
D-3	C40	CC45CH1H101J	CC 100pF ±5%		
D-3	C41	CC45CH1H101J	CC 100pF ±5%		
D-3	C42	CC45CH1H101J	CC 100pF ±5%		
D-2	C43	CC45CH1H101J	CC 100pF ±5%		
D-2	C44	CC45CH1H101J	CC 100pF ±5%		
E-2	C45	CK45D1H222M	CK 2200pF ±20%		
E-2	C46	CK45D1H222M	CK 2200pF ±20%		
E-2	C47	CK45D1H472M	CK 4700pF ±20%		
D-1	C48	CC45CH1H101J	CC 100pF ±5%		
C-2	C49	CK45D1H103M	CK 0.01µF ±20%		
	C50	CC45CH1H020C	CC 2pF ±0.25pF		

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description				Serial No. Eff
	C51	CC45CH1H010C	CC		1pF	±0.25pF	
	C52	CK45D1H102M	CK		1000pF	±20%	
	C53	CC45CH1H020C	CC		2pF	±0.25pF	
	C54	CC45CH1H010C	CC		1pF	±0.25pF	
	C55	CK45D1H102M	CK		1000pF	±20%	
	C56	CC45CH1H030C	CC		3pF	±0.25pF	
	C57	CC45CH1H030C	CC		3pF	±0.25pF	
	C58	No use					
	C59	No use					
	C60	No use					
	C61	CC45CH1H101C	CC		1pF	±0.25pF	
	C62	CC45CH1H010C	CC		1pF	±0.25pF	
	C63	CC45CH1H0R5C			0.5pF	±0.25pF	
	C64	No use					
	C65	CC45CH1H030C	CC		3pF	±0.25pF	
	C66	CC45CH1H010C	CC		1pF	±0.25pF	
	C67	CC45CH1H010C	CC		1pF	±0.25pF	
A-3	TC1	C05-0030-15	TC		20pF		
A-3	TC2	C05-0030-15	TC		20pF		
A-2	TC3	C05-0030-15	TC		20pF		
A-3	TC4	C05-0030-15	TC		20pF		
A-3	TC5	C05-0062-05	TC		6pF		
A-2	TC6	C05-0062-05	TC		6pF		
B-2	TC7	C05-0030-15	TC		20pF		
B-3	TC8	C05-0030-15	TC		20pF		
B-3	TC9	C05-0062-05	TC		6pF		
B-3	TC10	C05-0062-05	TC		6pF		
C-3	TC11	C05-0030-05	TC		20pF		
A-1	TC12	C05-0030-15	TC		20pF		
A-1	TC13	C05-0030-15	TC		20pF		
A-1	TC14	C05-0030-15	TC		20pF		
A-1	TC15	C05-0030-15	TC		20pF		
A-1	TC16	C05-0062-05	TC		6pF		
A-1	TC17	C05-0062-05	TC		6pF		
B-1	TC18	C05-0030-15	TC		20pF		
B-2	TC19	C05-0030-15	TC		20pF		
B-1	TC20	C05-0062-05	TC		6pF		
B-1	TC21	C05-0062-05	TC		6pF		
C-1	TC22	C05-0030-05	TC		20pF		
C-3	L1	L40-1001-02	Ferri-inductor		10μH		
C-3	L2	L40-1001-02	Ferri-inductor		10μH		
C-1	L3	L40-1001-02	Ferri-inductor		10μH		
C-1	L4	L40-1001-02	Ferri-inductor		10μH		
B-2	D1		Diode	Silicon	1S1544A	For switching	
C-3	D2		Diode	Silicon	DS442X	For switching	
B-3	D3		Diode	Silicon	1S1544A	For switching	
C-1	D4		Diode	Silicon	DS442X	For switching	
D-2	D5		Diode	Silicon	DS442X	For switching	
D-2	D6		Diode	Silicon	DS442X	For switching	
D-2	D7		Diode	Silicon	DS442X	For switching	
D-2	D8		Diode	Silicon	DS442X	For switching	
D-2	D9		Diode	Silicon	DS442X	For switching	
D-2	D10		Diode	Silicon	DS442X	For switching	
D-2	D11		Diode	Silicon	DS442X	For switching	
	D12		Diode	Zener	YZ-030	3V	
	D13		Diode	Zener	YZ-030	3V	
C-2	Q1		FET Dual	N-channel	U440	For VHF ~ UHF amp	
C-2	Q2		FET Dual	N-channel	U440	For VHF ~ UHF amp	
D-2	IC1		IC	Digital	MC14584BCP		
D-2	IC2		IC	Digital	MC14584BCP		
E-3	IC3		IC	Digital	MC14001BCP		

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff
D-2	IC4		IC Liner MC14027BCP	
E-3	IC5		IC Liner SN7404N	
E-2	IC6		IC Digital MC14174BCP	
D-1	IC7		IC Digital MC14081BCP	
E-2	IC8		IC Linear MC14503BCP	
E-2	IC9		IC Digital SN7432N	
D-1	IC10		IC Digital MC14027BCP	
E-1	IC11		IC Digital MC14503BCP	
C-2	IC12		IC Linear ATM-4010	
C-2	IC13		IC Linear ATM-4010	
D-2	P1	E40-1817-05	Pin connector 18P	
D-1	P2	E40-0717-05	Pin connector 7P	
C-3	P3	E40-0611-05	Pin connector 6P	
C-1	P4	E40-0611-05	Pin connector 6P	
E-3	P5	E40-1277-05	Pin connector 12P	
E-1	P6	E40-0577-05	Pin connector 5P	
		E23-0521-04	Earth terminal	
A-3	S1a	S01-4501-05	Rotary switch	
B-3	S1b	S01-4501-05	Rotary switch	
B-3	S1c	S01-4501-05	Rotary switch	
B-3	S1d	S01-4501-05	Rotary switch	
B-3	S1e	S01-4501-05	Rotary switch	
A-1	S2a	S01-4501-05	Rotary switch	
B-1	S2b	S01-4501-05	Rotary switch	
B-1	S2c	S01-4501-05	Rotary switch	
B-1	S2d	S01-4501-05	Rotary switch	
B-1	S2e	S01-4501-05	Rotary switch	
		J25-2929-02	Printed circuit board	

PARTS LIST

VERTICAL PREAMPLIFIER UNIT X73-1320-00

Fig. & Index No.	Ref. No.	Parts No.	Name & Description				Serial No. Eff.	
B-3	R1	RD14BB2B220J	RD	22Ω				
B-3	R2	RD14BB2B220J	RD	22Ω				
B-3	R3	RN14BK2B1000F	RN	100Ω	±1%	1/8W		
B-3	R4	RD14BB2B242J	RD	2.4kΩ				
B-3	R5	RD14BB2B181J	RD	180Ω				
B-3	R6	RN14BK2B2700F	RN	270Ω	±1%	1/8W		
B-3	R7	RD14BB2B101J	RD	100Ω				
B-3	R8	RN14BK2B2700F	RN	270Ω	±1%	1/8W		
B-2	R9	RD14BB2B112J	RD	1.1kΩ				
B-2	R10	RD14BB2B392J	RD	3.9kΩ				
B-2	R11	RD14BB2B220J	RD	22Ω				
B-3	R12	RD14BB2B220J	RD	22Ω				
B-3	R13	RN14BK2B3001F	RN	3kΩ	±1%	1/8W		
B-3	R14	RN14BK2B1801F	RN	1.8kΩ	±1%	1/8W		
B-3	R15	RN14BK2B3000F	RN	300Ω	±1%	1/8W		
B-3	R16	RN14BK2B7500F	RN	750Ω	±1%	1/8W		
B-2	R17	RN14BK2B7500F	RN	750Ω	±1%	1/8W		
B-3	R18	RN14BK2B5601F	RN	5.6kΩ	±1%	1/8W		
B-3	R19	RN14BK2B5601F	RN	5.6kΩ	±1%	1/8W		
	R20	RN14BK2B3901F	RN	3.9kΩ	±1%	1/8W		
	R21	RN14BK2B3901F	RN	3.9kΩ	±1%	1/8W		
B-3	R22	RN14BK2B1501F	RN	1.5kΩ	±1%	1/8W		
B-3	R23	RN14BK2B1501F	RN	1.5kΩ	±1%	1/8W		
B-3	R24	RD14BB2B220J	RD	22Ω				
B-2	R25	RD14BB2B220J	RD	22Ω				
	R26	No use						
B-3	R27	RN14BK2B4700F	RN	470Ω	±1%	1/8W		
B-3	R28	RN14BK2B4700F	RN	470Ω	±1%	1/8W		
B-3	R29	RN14BK2B51R0F	RN	51Ω	±1%	1/8W		
C-2	R30	RD14BB2B103J	RD	10kΩ				
C-2	R31	RD14BB2B472J	RD	4.7kΩ				
C-2	R32	RD14BB2B472J	RD	4.7kΩ				
C-2	R33	RD14BB2B103J	RD	10kΩ				
C-2	R34	RD14BB2B821J	RD	820Ω				
C-3	R35	RN14BK2B47R0F	RN	47Ω	±1%	1/8W		
C-3	R36	RN14BK2B4300F	RN	430Ω	±1%	1/8W		
C-3	R37	RN14BK2B4300F	RN	430Ω	±1%	1/8W		
C-3	R38	RD14BB2B271J	RD	270				
	R39	No use						
C-3	R40	RN14BK2B1500F	RN	150Ω	±1%	1/8W		
C-3	R41	RN14BK2B4300F	RN	430Ω	±1%	1/8W		
C-3	R42	RN14BK2B4300F	RN	430Ω	±1%	1/8W		
C-3	R43	No use						
C-3	R44	RD14BB2B220J	RD	22Ω				
C-3	R45	RD14BB2B220J	RD	22Ω				
C-3	R46	RN14BK2B1500F	RN	150Ω	±1%	1/8W		
C-2	R47	RD14BB2B123J	RD	12kΩ				
C-2	R48	RD14BB2B330J	RD	33Ω				
C-3	R49	RD14BB2B472J	RD	4.7kΩ				
C-3	R50	RN14BK2B9100F	RN	910Ω	±1%	1/8W		
C-2	R51	RN14BK2B9100F	RN	910Ω	±1%	1/8W		
C-3	R52	RD14BB2B470J	RD	47Ω				
C-2	R53	RD14BB2B470J	RD	47Ω				
C-3	R54	RN14BK2B2400F	RN	240Ω	±1%	1/8W		
C-2	R55	RD14BB2B103J	RD	10kΩ				
C-3	R56	RN14BK2B1101F	RN	1.1kΩ	±1%	1/8W		
C-2	R57	RN14BK2B1101F	RN	1.1kΩ	±1%	1/8W		
	R58	RD14BB2B682J	RD	6.8kΩ				
	R59	RN14BK2B3600F	RN	360Ω	±1%	1/8W		
C-3	R60	RN14BK2B2201F	RN	2.2kΩ	±1%	1/8W		
C-3	R61	RN14BK2B2201F	RN	2.2kΩ	±1%	1/8W		
C-3	R62	RN14BK2B1801F	RN	1.8kΩ	±1%	1/8W		
C-3	R63	RD14BB2B220J	RD	22Ω				
D-3	R64	RD14BB2B220J	RD	22Ω				

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description				Serial No. Eff.	
D-3	R65	RD14BB2B821J	RD	820Ω				
D-3	R66	RD14BB2B430J	RD	43Ω				
C-2	R67	RN14BK2B2201F	RN	2.2kΩ	±1%	1/8W		
C-2	R68	RN14BK2B2201F	RN	2.2kΩ	±1%	1/8W		
C-2	R69	RN14BK2B3600F	RN	360Ω	±1%	1/8W		
C-2	R70	RN14BK2B1601F	RN	1.6kΩ	±1%	1/8W		
C-2	R71	RD14BB2B220J	RD	22Ω				
D-2	R72	RD14BB2E821J	RD	820Ω				
D-2	R73	RD14BB2B430J	RD	43Ω				
D-3	R74	RD14BB2B220J	RD	22Ω				
D-2	R75	RD14BB2B220J	RD	22Ω				
D-2	R76	RD14BB2B132J	RD	1.3kΩ				
D-2	R77	RD14BB2B392J	RD	3.9kΩ				
D-3	R78	RD14BB2B220J	RD	22Ω				
D-2	R79	RD14BB2B220J	RD	22Ω				
D-2	R80	RD14BB2B101J	RD	100Ω				
D-3	R81	RD14BB2B101J	RD	100Ω				
D-2	R82	RD14BB2B101J	RD	100Ω				
D-3	R83	RD14BB2B102J	RD	1kΩ				
D-2	R84	RD14BB2B432J	RD	4.3kΩ				
	R85	RD14BB2B272J	RD	2.7kΩ				
	R86	RD14BB2B272J	RD	2.7kΩ				
	R87	No use						
D-3	R88	RD14BB2B102J	RD	1kΩ				
D-3	R89	RD14BB2B432J	RD	4.3kΩ				
D-3	R90	RD14BB2B101J	RD	100Ω				
D-3	R91	RD14BB2B101J	RD	100Ω				
D-3	R92	RD14BB2B101J	RD	100Ω				
D-3	R93	RD14BB2B220J	RD	22Ω				
D-3	R94	RD14BB2B220J	RD	22Ω				
D-3	R95	RD14BB2B132J	RD	1.3kΩ				
D-3	R96	RD14BB2B392J	RD	3.9kΩ				
D-3	R97	RD14BB2B220J	RD	22Ω				
D-3	R98	RD14BB2B220J	RD	22Ω				
E-3	R99	RN14BK2B3600F	RN	360Ω	±1%	1/8W		
E-3	R100	RN14BK2B2001F	RN	2kΩ	±1%	1/8W		
E-3	R101	RN14BK2B2201F	RN	2.2kΩ	±1%	1/8W		
E-3	R102	RN14BK2B1801F	RN	1.8kΩ	±1%	1/8W		
E-3	R103	RD14BB2B220J	RD	22Ω				
E-3	R104	RD14BB2B220J	RD	22Ω				
E-3	R105	RD14BB2B821J	RD	820Ω				
E-3	R106	RD14BB2B430J	RD	43Ω				
E-3	R107	RN14BK2B1101F	RN	1.1kΩ	±1%	1/8W		
E-3	R108	RN14BK2B1101F	RN	1.1kΩ	±1%	1/8W		
E-3	R109	RD14BB2B391J	RD	390Ω				
E-3	R110	RN14BK2B2001F	RN	2kΩ	±1%	1/8W		
D-3	R111	RD14BB2B470J	RD	47Ω				
D-3	R112	RD14BB2B470J	RD	47Ω				
E-3	R113	RN14BK2B7500F	RN	750Ω	±1%	1/8W		
D-3	R114	RN14BK2B7500F	RN	750Ω	±1%	1/8W		
D-3	R115	RD14BB2B221J	RD	220Ω				
D-3	R116	RD14BB2B273J	RD	27kΩ				
D-3	R117	RD14BB2B103J	RD	10kΩ				
E-3	R118	RD14BB2B221J	RD	220Ω				
D-3	R119	RD14BB2B151J	RD	150Ω				
D-3	R120	RD14BB2B151J	RD	150Ω				
E-3	R121	RD14BB2B510J	RD	51Ω				
E-3	R122	RD14BB2B510J	RD	51Ω				
D-2	R123	RD14BB2B103J	RD	10kΩ				
D-2	R124	RD14BB2B223J	RD	22kΩ				
D-2	R125	RD14BB2B223J	RD	22kΩ				
D-2	R126	RD14BB2B472J	RD	4.7kΩ				
D-2	R127	RD14BB2B472J	RD	4.7kΩ				
D-2	R128	RD14BB2B473J	RD	47kΩ				
D-2	R129	RD14BB2B473J	RD	47kΩ				
D-2	R130	RD14BB2B331J	RD	330Ω				

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff.	
D-2	R131	RD14BB2B472J	RD 4.7kΩ		
D-2	R132	RD14BB2B103J	RD 10kΩ		
D-2	R133	RN14BK2B4300F	RN 430Ω ±1% 1/8W		
D-2	R134	RN14BK2B4300F	RN 430Ω ±1% 1/8W		
D-2	R135	RN14BK2B4300F	RN 430Ω ±1% 1/8W		
D-2	R136	RN14BK2B4300F	RN 430Ω ±1% 1/8W		
E-2	R137	RN14BK2B1101F	RN 1.1kΩ ±1% 1/8W		
E-2	R138	RN14BK2B1101F	RN 1.1kΩ ±1% 1/8W		
	R139	No use			
E-2	R140	RN14BK2B4700F	RN 470Ω ±1% 1/8W		
D-2	R141	RN14BK2B3600F	RN 360Ω ±1% 1/8W		
E-2	R142	RN14BK2B2201F	RN 2.2kΩ ±1% 1/8W		
E-2	R143	RN14BK2B2201F	RN 2.2kΩ ±1% 1/8W		
D-2	R144	RN14BK2B1801F	RN 1.8kΩ ±1% 1/8W		
D-2	R145	RD14BB2B220J	RD 22Ω		
D-2	R146	RD14BB2B220J	RD 22Ω		
D-2	R147	RD14BB2B821J	RD 820Ω		
D-2	R148	RD14BB2B430J	RD 43Ω		
D-2	R149	RD14BB2B220J	RD 22Ω		
E-2	R150	RD14BB2B220J	RD 22Ω		
E-2	R151	RN14BK2B1101F	RN 1.1kΩ ±1% 1/8W		
E-2	R152	RN14BK2B9100F	RN 910Ω ±1% 1/8W		
E-2	R153	RN14BK2B9100F	RN 910Ω ±1% 1/8W		
E-2	R154	RN14BK2B1101F	RN 1.1kΩ ±1% 1/8W		
E-2	R155	RN14BK2B3300F	RN 330Ω ±1% 1/8W		
E-2	R156	RN14BK2B3300F	RN 330Ω ±1% 1/8W		
E-2	R157	RN14BK2B1001F	RN 1kΩ ±1% 1/8W		
E-2	R158	RN14BK2B2200F	RN 220Ω ±1% 1/8W		
E-2	R159	RN14BK2B1001F	RN 1kΩ ±1% 1/8W		
E-2	R160	RN14BK2B7500F	RN 750Ω ±1% 1/8W		
E-2	R161	RN14BK2B7500F	RN 750Ω ±1% 1/8W		
E-2	R162	RD14BB2B470J	RD 47Ω		
E-2	R163	RD14BB2B470J	RD 47Ω		
B-1	R164	RD14BB2B220J	RD 22Ω		
B-1	R165	RD14BB2B220J	RD 22Ω		
B-2	R166	RN14BK2B1000F	RN 100Ω ±1% 1/8W		
B-2	R167	RD14BB2B181J	RD 180Ω		
B-2	R168	RD14BB2B682J	RD 6.8kΩ		
B-2	R169	RN14BK2B2700F	RN 270Ω ±1% 1/8W		
B-2	R170	RN14BK2B2700F	RN 270Ω ±1% 1/8W		
B-2	R171	RN14BK2B1801F	RN 1.8kΩ ±1% 1/8W		
B-2	R172	RN14BK2B5601F	RN 5.6kΩ ±1% 1/8W		
B-2	R173	RN14BK2B1801F	RN 1.8kΩ ±1% 1/8W		
B-2	R174	RN14BK2B5101F	RN 5.1kΩ ±1% 1/8W		
B-2	R175	RN14BK2B3000F	RN 300Ω ±1% 1/8W		
B-2	R176	RD14BB2B331J	RD 330Ω		
B-2	R177	RN14BK2B2201F	RN 2.2kΩ ±1% 1/8W		
B-2	R178	RN14BK2B6801F	RN 6.8kΩ ±1% 1/8W		
B-2	R179	RN14BK2B2201F	RN 2.2kΩ ±1% 1/8W		
	R180	RD14BB2B273J	RD 27kΩ		
B-1	R181	RD14BB2B220J	RD 22Ω		
B-1	R182	RD14BB2B220J	RD 22Ω		
B-1	R183	RD14BB2B112J	RD 1.1kΩ		
B-1	R184	RD14BB2B392J	RD 3.9kΩ		
B-1	R185	RD14BB2B220J	RD 22Ω		
B-1	R186	RD14BB2B220J	RD 22Ω		
B-1	R187	RD14BB2B112J	RD 1.1kΩ		
B-1	R188	RD14BB2B392J	RD 3.9kΩ		
B-1	R189	RN14BK2B7500F	RN 750Ω ±1% 1/8W		
B-1	R190	RN14BK2B7500F	RN 750Ω ±1% 1/8W		
B-1	R191	RN14BK2B5601F	RN 5.6kΩ ±1% 1/8W		
B-1	R192	RN14BK2B5601F	RN 5.6kΩ ±1% 1/8W		
B-1	R193	RN14BK2B3901F	RN 3.9kΩ ±1% 1/8W		
B-1	R194	RN14BK2B3901F	RN 3.9kΩ ±1% 1/8W		
B-1	R195	RN14BK2B1501F	RN 1.5kΩ ±1% 1/8W		
B-1	R196	RN14BK2B1501F	RN 1.5kΩ ±1% 1/8W		

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff.	
B-2	R197	RD14BB2B220J	RD 22Ω		
B-1	R198	RD14BB2B220J	RD 22Ω		
	R199	No use			
B-1	R200	RN14BK2B4700F	RN 470Ω ±1% 1/8W		
B-1	R201	RN14BK2B4700F	RN 470Ω ±1% 1/8W		
B-2	R202	RN14BK2B51R0F	RN 51Ω ±1% 1/8W		
C-2	R203	RD14BB2B103J	RD 10kΩ		
C-2	R204	RD14BB2B472J	RD 4.7kΩ		
C-2	R205	RD14BB2B472J	RD 4.7kΩ		
C-2	R206	RD14BB2B103J	RD 10kΩ		
C-2	R207	RD14BB2B821J	RD 820Ω		
C-2	R208	RN14BK2B47R0F	RN 47Ω ±1% 1/8W		
C-1	R209	RN14BK2B4300F	RN 430Ω ±1% 1/8W		
C-1	R210	RN14BK2B4300F	RN 430Ω ±1% 1/8W		
C-1	R211	RD14BB2B301J	RD 300Ω		
	R212	No use			
C-1	R213	RN14BK2B1500F	RN 150Ω ±1% 1/8W		
C-2	R214	RN14BK2B4300F	RN 430Ω ±1% 1/8W		
C-1	R215	RN14BK2B4300F	RN 430Ω ±1% 1/8W		
	R216	No use			
C-2	R217	RD14BB2B220J	RD 22Ω		
C-1	R218	RD14BB2B220J	RD 22Ω		
C-1	R219	RN14BK2B1500F	RN 150Ω ±1% 1/8W		
C-1	R220	RD14BB2B123J	RD 12kΩ		
	R221	RD14BB2B330J	RD 33Ω		
C-1	R222	RD14BB2B682J	RD 6.8kΩ		
C-1	R223	RN14BK2B9100F	RN 910Ω ±1% 1/8W		
C-1	R224	RN14BK2B9100F	RN 910Ω ±1% 1/8W		
C-1	R225	RD14BB2B470J	RD 47Ω		
C-1	R226	RD14BB2B470J	RD 47Ω		
C-1	R227	RN14BK2B1500F	RN 150Ω ±1% 1/8W		
	R228	No use			
C-1	R229	RN14BK2B1101F	RN 1.1kΩ ±1% 1/8W		
C-1	R230	RN14BK2B1101F	RN 1.1kΩ ±1% 1/8W		
C-2	R231	RN14BK2B3600F	RN 360Ω ±1% 1/8W		
C-2	R232	RN14BK2B2201F	RN 2.2kΩ ±1% 1/8W		
C-2	R233	RN14BK2B2201F	RN 2.2kΩ ±1% 1/8W		
C-2	R234	RN14BK2B1801F	RN 1.8kΩ ±1% 1/8W		
C-2	R235	RD14BB2B220J	RD 22Ω		
C-2	R236	RD14BB2B220J	RD 22Ω		
D-2	R237	RD14BB2B821J	RD 820Ω		
D-2	R238	RD14BB2B430J	RD 43Ω		
D-1	R239	RD14BB2B220J	RD 22Ω		
D-1	R240	RD14BB2B220J	RD 22Ω		
D-1	R241	RD14BB2B132J	RD 1.3kΩ		
D-1	R242	RD14BB2B392J	RD 3.9kΩ		
D-1	R243	RD14BB2B220J	RD 22Ω		
D-1	R244	RD14BB2B220J	RD 22Ω		
D-1	R245	RD14BB2B101J	RD 100Ω		
D-1	R246	RD14BB2B101J	RD 100Ω		
D-1	R247	RD14BB2B101J	RD 100Ω		
D-1	R248	RD14BB2B102J	RD 1kΩ		
D-1	R249	RD14BB2B432J	RD 4.3kΩ		
D-1	R250	RD14BB2B102J	RD 1kΩ		
D-1	R251	RD14BB2B432J	RD 4.3kΩ		
D-1	R252	RD14BB2B101J	RD 100Ω		
D-1	R253	RD14BB2B101J	RD 100Ω		
D-1	R254	RD14BB2B101J	RD 100Ω		
D-1	R255	RD14BB2B220J	RD 22Ω		
D-1	R256	RD14BB2B220J	RD 22Ω		
D-1	R257	RD14BB2B132J	RD 1.3kΩ		
D-1	R258	RD14BB2B392J	RD 3.9kΩ		
D-1	R259	RD14BB2B220J	RD 22Ω		
D-1	R260	RD14BB2B220J	RD 22Ω		
E-1	R261	RN14BK2B3600F	RN 360Ω ±1% 1/8W		
E-1	R262	RN14BK2B2001F	RN 2kΩ ±1% 1/8W		

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description				Serial No. Eff.	
E-1	R263	RN14BK2B2201F	RN	2.2kΩ	±1%	1/8W		
E-1	R264	RN14BK2B1801F	RN	1.8kΩ	±1%	1/8W		
E-1	R265	RD14BB2B220J	RD	22Ω				
E-1	R266	RD14BB2B220J	RD	22Ω				
E-1	R267	RD14BB2B821J	RD	820Ω				
E-1	R268	RD14BB2B430J	RD	43Ω				
E-1	R269	RN14BK2B1101F	RN	1.1kΩ	±1%	1/8W		
E-1	R270	RN14BK2B1101F	RN	1.1kΩ	±1%	1/8W		
E-1	R271	RD14BB2B391J	RD	390Ω				
E-1	R272	RN14BK2B2001F	RN	2kΩ	±1%	1/8W		
D-1	R273	RD14BB2B470J	RD	47Ω				
D-1	R274	RD14BB2B470J	RD	47Ω				
E-1	R275	RN14BK2B7500F	RN	750Ω	±1%	1/8W		
D-1	R276	RN14BK2B7500F	RN	750Ω	±1%	1/8W		
D-1	R277	RD14BB2B221J	RD	220Ω				
D-1	R278	RD14BB2B273J	RD	27kΩ				
D-1	R279	RD14BB2B103J	RD	10kΩ				
E-1	R280	RD14BB2B221J	RD	220Ω				
D-1	R281	RD14BB2B151J	RD	150Ω				
D-1	R282	RD14BB2B151J	RD	150Ω				
E-1	R283	RD14BB2B510J	RD	51Ω				
E-1	R284	RD14BB2B510J	RD	51Ω				
E-2	R285	RD14BB2B472J	RD	4.7kΩ				
F-2	R286	RD14BB2B103J	RD	10kΩ				
F-2	R287	RD14BB2B103J	RD	10kΩ				
E-2	R288	RD14BB2B103J	RD	10kΩ				
E-2	R289	RD14BB2B103J	RD	10kΩ				
	R290	No use						
	R291	No use						
C-2	R292	RD14BB2B220J	RD	22Ω				
	R293	No use						
	R294	No use						
B-1	R295	RD14BB2B330J	RD	33Ω				
B-1	R296	RD14BB2B122J	RD	1.2kΩ				
	R297	No use						
	R298	No use						
E-2	R299	RD14BB2B222J	RD	2.2kΩ				
E-2	R300	RD14BB2B222J	RD	2.2kΩ				
E-2	R301	RD14BB2B222J	RD	2.2kΩ				
	R302	No use						
	R303	No use						
	R304	RD14BB2B220J	RD	22Ω				
	R305	RD14BB2B220J	RD	22Ω				
	R306	RD14BB2B101J	RD	100Ω				
	R307	RN14BK2B1501F	RN	1.5kΩ	±1%	1/8W		
	R308	RN14BK2B1501F	RN	1.5kΩ	±1%	1/8W		
	R309	RD14BB2B470J	RD	47Ω				
	R310	RD14BB2B470J	RD	47Ω				
	R311	No use						
	R312	RD14BB2B470J	RD	47Ω				
	R313	RD14BB2B470J	RD	47Ω				
	R314	RD14BB2B470J	RD	47Ω				
	R315	RD14BB2B470J	RD	47Ω				
	R316	RD14BB2B470J	RD	47Ω				
	R317	RD14BB2B473J	RD	47kΩ				
	R318	RD14BB2B473J	RD	47kΩ				
	R319	RD14BB2B103J	RD	10kΩ				
	R320	RD14BB2B822J	RD	8.2kΩ				
	R321	RD14BB2B103J	RD	10kΩ				
	R322	RD14BB2B103J	RD	10kΩ				
	R323	RD14BB2B752J	RD	7.5kΩ				
	R324	RD14BB2B332J	RD	3.3kΩ				
	R325	RD14BB2B271J	RD	270Ω				
	R326	RD14BB2B271J	RD	270Ω				
	R327	RD14BB2B220J	RD	22Ω				
	R328	RD14BB2B220J	RD	22Ω				

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No Eff	
E-3	VR1	R01-0512-05	VR 500Ω B		See Page 11-6
E-1	VR2	R01-0512-05	VR 500Ω B		See Page 11-6
B-3	VR3	R12-0529-05	VR 100Ω B		
B-3	VR4	R12-0529-05	VR 100Ω B		
C-3	VR5	R12-0529-05	VR 100Ω B		
C-3	VR6	R12-0529-05	VR 100Ω B		
C-3	VR7	R12-0530-05	VR 200Ω B		
C-2	VR8	R12-0530-05	VR 200Ω B		
C-2	VR9	R12-0531-05	VR 500Ω B		
E-3	VR10	R12-0530-05	VR 200Ω B		
E-3	VR11	R12-0529-05	VR 100Ω B		
E-2	VR12	R12-0531-05	VR 500Ω B		
B-2	VR13	R12-0529-05	VR 100Ω B		
B-2	VR14	R12-0529-05	VR 100Ω B		
B-2	VR15	R12-0529-05	VR 100Ω B		
C-1	VR16	R12-0529-05	VR 100Ω B		
C-1	VR17	R12-0529-05	VR 100Ω B		
C-1	VR18	R12-0530-05	VR 200Ω B		
C-1	VR19	R12-0530-05	VR 200Ω B		
E-1	VR20	R12-0530-05	VR 200Ω B		
E-1	VR21	R12-0529-05	VR 100Ω B		
D-2	VR22	R12-0530-05	VR 200Ω B		
B-3	C1	CC45CH1H150J	CC 15pF ±5%		
B-3	C2	CC45CH1H150J	CC 15pF ±5%		
B-3	C3	CK45D1H103M	CK 0.01μF ±20%		
B-3	C4	CK45D1H103M	CK 0.01μF ±20%		
	C5	No use			
C-3	C6	CC45CH1H020C	CC 2pF ±0.25pF		
B-2	C7	CK45D1H103M	CK 0.01μF ±20%		
C-2	C8	CK45D1H103M	CK 0.01μF ±20%		
C3	C9	CC45CH1H330J	CC 33pF ±5%		
	C10	No use			
C-3	C11	CK45D1H222M	CK 2200pF ±10%		
	C12	No use			
C-2	C13	CC45CH1H270J	CC 27pF ±5%		
C-3	C14	CC45CH1H220J	CC 22pF ±5%		
C-3	C15	CK45D1H103M	CC 0.01μF ±20%		
C-2	C16	No use			
	C17	No use			
	C18	No use			
E-3	C19	CC45CH1H030J	CC 3pF ±0.25pF		
E-3	C20	CC45CH1H070D	CC 7pF ±0.5pF		
D-3	C21	CK45D1H102M	CK 1000pF ±20%		
D-3	C22	CC45CH1H220J	CC 22pF ±5%		
E-3	C23	CC45CH1H680J	CC 68pF ±5%		
D-2	C24	CK45D1H103M	CK 0.01μF ±20%		
D-2	C25	CC45CH1H151J	CC 150pF ±5%		
D-2	C26	CC45CH1H151J	CC 150pF ±5%		
D-2	C27	CK45D1H103M	CK 0.01μF ±20%		
E-2	C28	CC45CH1H220J	CC 22pF ±5%		
	C29	No use			
	C30	No use			
E-2	C31	CC45CH1H020C	CC 2pF ±0.25pF		
E-2	C32	CC45CH1H050C	CC 5pF ±0.25pF		
	C33	No use			
	C34	CC45CH1H150J	CC 15pF ±5%		
	C35	CC45CH1H150J	CC 15pF ±5%		
E-2	C36	CC45CH1H070D	CC 7pF ±0.5pF		
E-2	C37	CC45CH1H070D	CC 7pF ±0.5pF		
B-2	C38	CC45CH1H150J	CC 15pF ±5%		
B-2	C39	CC45SL1H680J	CC 68pF ±5%		
B-1	C40	CK45D1H103M	CK 0.01μF ±20%		
B-1	C41	CK45D1H103M	CK 0.01μF ±20%		
	C42	No use			
C-1	C43	CC45CH1H020C	CC 2pF ±0.25pF		
C-2	C44	CK45D1H103M	CK 0.01μF ±20%		
C-2	C45	CK45D1H103M	CK 0.01μF ±20%		

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff.	
C-1	C46	CC45CH1H330J	CC 33pF ±5%		
	C47	No use			
C-1	C48	CK45D1H222M	CK 2200pF ±20%		
	C49	No use			
C-1	C50	CC45CH1H390J	CC 39pF ±5%		
C-1	C51	CC45CH1H220J	CC 22pF ±5%		
	C52	No use			
C-1	C53	CC45CH1H220J	CC 22pF ±5%		
D-1	C54	CK45D1H103M	CK 0.01μF ±20%		
D-1	C55	CK45D1H103M	CK 0.01μF ±20%		
E-1	C56	CC45CH1H030C	CC 3pF ±0.25pF		
E-1	C57	CC45CH1H070D	CC 7pF ±0.5pF		
D-1	C58	CK45D1H102M	CK 1000pF ±20%		
D-1	C59	CC45CH1H220J	CC 22pF ±5%		
E-1	C60	CC45CH1H680J	CC 68pF ±5%		
B-2	C61	CK45D1H103M	CK 0.01μF ±20%		
B-3	C62	CK45D1H103M	CK 0.01μF ±20%		
B-2	C63	CE04W1C101M	CE 100μF 16WV		
B-3	C64	CK45D1H103M	CK 0.01μF ±20%		
B-3	C65	CE04W1C101M	CE 100μF 16WV		
B-2	C66	CK45D1H103M	CK 0.01μF ±20%		
C-2	C67	CE04W1C101M	CE 100μF 16WV		
C-3	C68	CK45D1H103M	CK 0.01μF ±20%		
C-3	C69	CK45D1H103M	CK 0.01μF ±20%		
C-3	C70	CE04W1C101M	CE 100μF 16WV		
C-2	C71	CK45D1H103M	CK 0.01μF ±20%		
C-2	C72	CK45D1H103M	CK 0.01μF ±20%		
C-3	C73	CK45D1H103M	CK 0.01μF ±20%		
C-2	C74	CK45D1H103M	CK 0.01μF ±20%		
C-2	C75	CE04W1C101M	CE 100μF 16WV		
C-2	C76	CE04W1C101M	CE 100μF 16WV		
	C77	CE04W1C331M	CE 330μF 16WV		
D-3	C78	CE04W1C101M	CE 100μF 16WV		
E-3	C79	CK45D1H103M	CK 0.01μF ±20%		
	C80	CE04W1C331M	CE 330μF 16WV		
	C81	CE04W1C221M	CE 220μF 16WV		
F-3	C82	CE04W1C471M	CE 470μF 16WV		
	C83	CE04W1C221M	CE 220μF 16WV		
F-3	C84	CE04W1C470M	CE 47μF 16WV		
B-1	C85	CK45D1H103M	CK 0.01μF ±20%		
B-2	C86	CK45D1H103M	CK 0.01μF ±20%		
B-1	C87	CK45D1H103M	CK 0.01μF ±20%		
B-1	C88	CE04W1C101M	CE 100μF 16WV		
B-2	C89	CK45D1H103M	CK 0.01μF ±20%		
	C90	CK45D1H103M	CK 0.01μF ±20%		
B-2	C91	CE04W1C101M	CE 100μF 16WV		
B-1	C92	CK45D1H103M	CK 0.01μF ±20%		
B-1	C93	CE04W1C101M	CE 100μF 16WV		
C-2	C94	CK45D1H103M	CK 0.01μF ±20%		
C-1	C95	CK45D1H103M	CK 0.01μF ±20%		
C-2	C96	CK45D1H103M	CK 0.01μF ±20%		
C-2	C97	CK45D1H103M	CK 0.01μF ±20%		
C-2	C98	CE04W1C101M	CE 100μF 16WV		
C-2	C99	CE04W1C101M	CE 100μF 16WV		
C-1	C100	CK45D1H103M	CK 0.01μF ±20%		
C-1	C101	CE04W1C101M	CE 100μF 16WV		
	C102	No use			
C-2	C103	CK45D1H103M	CK 0.01μF ±20%		
D-1	C104	CE04W1C101M	CE 100μF 16WV		
F-1	C105	CE04W1C471M	CE 470μF 16WV		
E-1	C106	CK45D1H103M	CK 0.01μF ±20%		
E-2	C107	CK45D1H103M	CK 0.01μF ±20%		
	C108	CC45SL1H680J	CC 68pF ±5%		
F-1	C109	CE04W1C470M	CE 47μF 16WV		
F-2	C110	CK45D1H103M	CK 0.01μF ±20%		
F-1	C111	CK45D1H103M	CK 0.01μF ±20%		

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No Eff	
F-1	C112	CK45D1H103M	CK 0.01μF ±20%		
	C113	No use			
	C114	No use			
	C115	No use			
	C116	No use			
D-3	C117	CC45SL1H101J	CC 100pF ±5%		
E-3	C118	CC45SL1H101J	CC 100pF ±5%		
D-2	C119	CC45SL1H101J	CC 100pF ±5%		
B-1	C120	CC45CH1H150J	CC 15pF ±5%		
B-1	C121	CC45CH1H180J	CC 18pF ±5%		
D-2	C122	CC45SL1H101J	CC 100pF ±5%		
E-1	C123	CC45SL1H101J	CC 100pF ±5%		
D-3	C124	C91-0549-05	Tantalum 1μF 35WV		
D-2	C125	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV		
D-2	C126	CC45SL1H101J	CC 100pF ±5%		
F-3	C127	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV		
D-2	C128	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV		
D-2	C129	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV		
F-1	C130	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV		
	C131	CC45CH1H120J	CC 12pF ±5%		
	C132	CC45CH1H120J	CC 12pF ±5%		
	C133	No use			
	C134	No use			
	C135	CC45CH1H150J	CC 15pF ±5%		
	C136	CC45CH1H150J	CC 15pF ±5%		
	C137	No use			
	C138	CC45CH1H150J	CC 15pF ±5%		
	C139	No use			
	C140	CC45CH1H030C	CC 3pF ±0.25pF		
	C141	CC45CH1H030C	CC 3pF ±0.25pF		
	C142	CK45D1H103M	CK 0.01μF ±20%		
	C143	CK45D1H103M	CK 0.01μF ±20%		
	C144	No use			
	C145	No use			
	C146	CC45CH1H030C	CC 3pF ±0.25pF		
	C147	CC45CH1H030C	CC 3pF ±0.25pF		
	C148	No use			
	C149	No use			
A-3	C150	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV		
	C151	CC45SL1H680J	CC 68pF ±5%		
	C152	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV		
	C153	CC45SL1H680J	CC 68pF ±5%		
	C154	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV		
	C155	No use			
	C156	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV		
	C157	CC45SL1H680J	CC 68pF ±5%		
	C158	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV		
	C159	CK45D1H103M	CK 0.01μF ±20%		
	C160	CC45CH1H050C	CC 5pF ±0.25pF		
	C161	CC45CH1H050C	CC 5pF ±0.25pF		
A-1	C162	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV		
	C163	CC45SL1H680J	CC 68pF ±5%		
	C164	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV		
	C165	CC45SL1H680J	CC 68pF ±5%		
	C166	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV		
	C167	CC45CH1H150J	CC 15pF ±5%		
	C168	CC45CH1H150J	CC 15pF ±5%		
	C169	CC45CH1H150J	CC 15pF ±5%		
	C170	CC45CH1H150J	CC 15pF ±5%		
	C171	CC45CH1H150J	CC 15pF ±5%		
	C172	CC45CH1H150J	CC 15pF ±5%		
	C173	CC45CH1H010C	CC 1pF ±0.25pF		
	C174	CC45CH1H010C	CC 1pF ±0.25pF		
	C175	CC45SL1H680J	CC 68pF ±5%		
	C176	CC45SL1H680J	CC 68pF ±5%		

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff
B-3	TC1	C05-0030-15	TC 20pF	
C-3	TC2	C05-0030-15	TC 20pF	
D-3	TC3	C05-0030-15	TC 20pF	
D-3	TC4	C05-0030-15	TC 20pF	
B-1	TC5	C05-0030-15	TC 20pF	
C-1	TC6	C05-0030-15	TC 20pF	
D-1	TC7	C05-0030-15	TC 20pF	
D-1	TC8	C05-0030-15	TC 20pF	
C-2	TC9	C05-0030-15	TC 20pF	
C-3	TC10	C05-0030-15	TC 20pF	
C-1	TC11	C05-0030-15	TC 20pF	
B-3	L1	L40-2201-03	Ferri-inductor 22μH	
	L2	L40-2201-03	Ferri-inductor 22μH	
C-2	L3	L40-2201-03	Ferri-inductor 22μH	
	L4	No use		
	L5	No use		
D-3	L6	L40-2201-03	Ferri-inductor 22μH	
B-1	L7	L40-2201-03	Ferri-inductor 22μH	
C-2	L8	L40-2201-03	Ferri-inductor 22μH	
C-1	L9	L40-2201-03	Ferri-inductor 22μH	
	L10	No use		
D-1	L11	L40-2201-03	Ferri-inductor 22μH	
	L12	L40-6882-01	Ferri-inductor 0.68μH	
D-3	D1		Diode Silicon DS442X For switching	
D-1	D2		Diode Silicon DS442X For switching	
D-3	D3		Diode Silicon DS442X For switching	
D-1	D4		Diode Silicon DS442X For switching	
B-2	D5		Diode Silicon DS442X For switching	
B-2	D6		Diode Silicon DS442X For switching	
D-3	D7		Diode Silicon DS442X For switching	
D-3	D8		Diode Silicon DS442X For switching	
D-3	D9		Diode Silicon DS442X For switching	
D-3	D10		Diode Silicon DS442X For switching	
D-2	D11		Diode Zener WZ-071 7.1V	
D-2	D12		Diode Zener WZ-071 7.1V	
D-2	D13		Diode Silicon DS442X For switching	
E-2	D14		Diode Silicon DS442X For switching	
F-2	D15		Diode Silicon DS442X For switching	
E-2	D16		Diode Silicon DS442X For switching	
E-2	D17		Diode Silicon DS442X For switching	
E-2	D18		Diode Silicon DS442X For switching	
F-2	D19		Diode Silicon DS442X For switching	
E-2	D20		Diode Silicon DS442X For switching	
E-2	D21		Diode Silicon DS442X For switching	
E-2	D22		Diode Silicon DS442X For switching	
E-2	D23		Diode Silicon DS442X For switching	
E-2	D24		Diode Silicon DS442X For switching	
F-2	D25		Diode Silicon DS442X For switching	
F-2	D26		Diode Silicon DS442X For switching	
E-2	D27		Diode Silicon DS442X For switching	
F-2	D28		Diode Silicon DS442X For switching	
F-2	D29		Diode Silicon DS442X For switching	
C-3	D30		Diode Silicon DS442X For switching	
C-2	D31		Diode Silicon DS442X For switching	
E-3	D32		Diode Silicon DS442X For switching	
D-2	D33		Diode Silicon DS442X For switching	
C-2	D34		Diode Silicon DS442X For switching	
E-1	D35		Diode Silicon DS442X For switching	
	D36		Diode Zener WZ-061 6.1V	
	D37		Diode Zener WZ-061 6.1V	
	D38		Diode Silicon DS442X For switching	
	D39		Diode Silicon DS442X For switching	
	D40		Diode Silicon 1S2688 Variable capacitance	
	D41		Diode Silicon 1S2686 Variable capacitance	
	D42		Diode Silicon 1S2686 Variable capacitance	

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description					Serial No. Eff
	D43		Diode		Silicon	1S2686	Variable capacitance	
	D44		Diode		Silicon	DS442X	For switching	
	D45		Diode		Silicon	DS442X	For switching	
	D46		Diode		Silicon	DS442X	For switching	
B-3	Q1		TR	NPN	Silicon	2SC536KNP(F)	For high frequency amp	
B-3	Q2		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
B-2	Q3		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
C-3	Q4		TR	PNP	Silicon	2SA838(C)	For high frequency, small signal	
C-3	Q5		TR	PNP	Silicon	2SA838(C)	For high frequency, small signal	
C-3	Q6		TR	PNP	Silicon	2SA838(C)	For high frequency, small signal	
C-3	Q7		TR	PNP	Silicon	2SA838(C)	For high frequency, small signal	
B-2	Q8		TR	PNP	Silicon	2SA608KNP(F)	For universal	
C-2	Q9		TR	PNP	Silicon	2SA608KNP(F)	For universal	
C-3	Q10		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
C-2	Q11		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
C-3	Q12		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
C-2	Q13		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
C-3	Q14		TR	PNP	Silicon	2SA1161	For high speed switching	
D-3	Q15		TR	NPN	Silicon	2SC2499	For VHF ~ UHF, low noise	
C-2	Q16		TR	PNP	Silicon	2SA1161	For high speed switching	
C-2	Q17		TR	NPN	Silicon	2SC2499	For VHF ~ UHF, low noise	
D-3	Q18		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
D-3	Q19		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
D-2	Q20		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
D-2	Q21		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
	Q22	No use						
D-3	Q23		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
D-3	Q24		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
D-3	Q25		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
D-3	Q26		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
E-3	Q27		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
E-3	Q28		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
E-3	Q29		TR	PNP	Silicon	2SA1161	For high speed switching	
E-3	Q30		TR	NPN	Silicon	2SC2499	For VHF ~ UHF, low noise	
D-3	Q31		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
D-3	Q32		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
D-2	Q33		TR	PNP	Silicon	2SA608KNP(F)	For universal	
D-2	Q34		TR	NPN	Silicon	2SC536KNP(F)	For high frequency amp	
D-2	Q35		TR	NPN	Silicon	2SC1047(C)	For high frequency amp	
D-2	Q36		TR	NPN	Silicon	2SC1047(C)	For high frequency amp	
D-2	Q37		TR	PNP	Silicon	2SA608KNP(F)	For universal	
E-2	Q38		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
E-2	Q39		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
D-2	Q40		TR	PNP	Silicon	2SA1161	For high speed switching	
D-2	Q41		TR	NPN	Silicon	2SC2499	For VHF ~ UHF, low noise	
E-2	Q42		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
E-2	Q43		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
E-2	Q44		TR	PNP	Silicon	2SA1161	For high speed switching	
E-2	Q45		TR	PNP	Silicon	2SA1161	For high speed switching	
B-2	Q46		TR	NPN	Silicon	2SC536KNP(F)	For high frequency amp	
B-2	Q47		TR	NPN	Silicon	2SC536KNP(F)	For high frequency amp	
B-2	Q48		TR	NPN	Silicon	2SC536KNP(F)	For high frequency amp	
B-2	Q49		TR	NPN	Silicon	2SC536KNP(F)	For high frequency amp	
B-1	Q50		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
B-1	Q51		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
C-2	Q52		TR	PNP	Silicon	2SA838(C)	For high frequency, small signal	
C-1	Q53		TR	PNP	Silicon	2SA838(C)	For high frequency, small signal	
C-2	Q54		TR	PNP	Silicon	2SA838(C)	For high frequency, small signal	
C-1	Q55		TR	PNP	Silicon	2SA838(C)	For high frequency, small signal	
C-2	Q56		TR	PNP	Silicon	2SA608KNP(F)	For universal	
C-2	Q57		TR	PNP	Silicon	2SA608KNP(F)	For universal	
C-2	Q58		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
C-1	Q59		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
C-1	Q60		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	
C-1	Q61		TR	NPN	Silicon	2SC1215(T or S)	For high frequency amp	

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff
C-2	Q62		TR PNP Silicon 2SA1161 For high speed switching	
C-2	Q63		TR NPN Silicon 2SC2499 For VHF ~ UHF, low noise	
D-1	Q64		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
D-2	Q65		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
D-1	Q66		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
D-1	Q67		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
D-1	Q68		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
D-1	Q69		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
D-1	Q70		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
D-1	Q71		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
E-1	Q72		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
E-1	Q73		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
E-1	Q74		TR PNP Silicon 2SA1161 For high speed switching	
E-1	Q75		TR PNP Silicon 2SC2499 For VHF ~ UHF, low noise	
D-1	Q76		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
D-1	Q77		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
E-2	Q78		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
	Q79		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
B-3	IC1		IC Linear CA3102E	
B-1	IC2		IC Linear CA3102E	
E-3	IC3		IC Digital SN74LS32N	
E-2	IC4		IC Digital SN74LS11N	
E-2	IC5		IC Digital SN74LS112AN	
E-1	IC6		IC Digital SN74LS08N	
E-1	IC7		IC Digital SN74LS00N	
	TH1		Thermistor SDT-1000	
A-3	P3	E40-0618-05	Pin connector 6P	
A-1	P4	E40-0618-05	Pin connector 6P	
F-2	P5	E40-1276-05	Pin connector 12P	
	P6	No use		
B-2	P7	E40-0576-05	Pin connector 5P	
C-2	P8	E40-0576-05	Pin connector 5P	
E-2	P9	E40-0376-05	Pin connector 3P	
	P10	No use		
E-3	P11	E40-0476-05	Pin connector 4P	
E-1	P12	E40-0476-05	Pin connector 4P	
	P13	No use		
F-2	P14	E40-0776-05	Pin connector 7P	
D-3	P15	E40-0276-05	Pin connector 2P	
D-2	P16	E40-0276-05	Pin connector 2P	
F-3	P17	E40-0276-05	Pin connector 2P	
F-1	P18	E40-0276-05	Pin connector 2P	
D-1	P19	E40-0276-05	Pin connector 2P	
F-1	P20	E40-0576-05	Pin connector 5P	
D-2	P21	E40-0276-05	Pin connector 2P	
	TP	E40-0211-05	Pin connector 2P	
		L92-0110-05	Core (beads type)	
		J25-2090-02	Printed circuit board	

PARTS LIST

VERTICAL OUTPUT AMPLIFIER UNIT X73-1330-00

Fig. & Index No.	Ref. No.	Parts No.	Name & Description				Serial No. Eff.	
E-3	R1	RN14BK2B91R0F	RN	91Ω	±1%	1/8W		
E-3	R2	RN14BK2B91R0F	RN	91Ω	±1%	1/8W		
E-2	R3	RD14BB2B220J	RD	22Ω				
E-3	R4	RD14BB2B220J	RD	22Ω				
E-3	R5	RD14BB2B100J	RD	10Ω				
	R6	No use						
E-3	R7	RD14BB2B332J	RD	3.3kΩ				
E-2	R8	RN14BK2B27R0F	RN	27Ω	±1%	1/8W		
E-3	R9	RN14BK2B27R0F	RN	27Ω	±1%	1/8W		
D-2	R10	RD14BB2B220J	RD	22Ω				
D-3	R11	RD14BB2B220J	RD	22Ω				
D-3	R12	RD14BB2B302J	RD	3kΩ				
D-2	R13	RD14BB2B122J	RD	1.2kΩ				
D-2	R14	RD14BB2B220J	RD	22Ω				
D-3	R15	RD14BB2B220J	RD	22Ω				
D-2	R16	RN14BK2B6200F	RN	620Ω	±1%	1/8W		
D-3	R17	RN14BK2B6200F	RN	620Ω	±1%	1/8W		
C-2	R18	RD14BB2B220J	RD	22Ω				
C-3	R19	RD14BB2B220J	RD	22Ω				
D-3	R20	RD14BB2B470J	RD	47Ω				
D-3	R21	RD14BB2B220J	RD	22Ω				
D-3	R22	RD14BB2B151J	RD	150Ω				
	R23	No use						
	R24	No use						
C-2	R25	RD14BB2B102J	RD	1kΩ				
C-3	R26	RD14BB2B822J	RD	8.2kΩ				
C-2	R27	RD14BB2E560J	RD	56Ω	±5%	1/4W		
C-3	R28	RD14BB2E560J	RD	56Ω	±5%	1/4W		
C-3	R29	RS14AB3D820J	RS	82Ω	±5%	2W		
C-2	R30	RD14BB2B100J	RD	10Ω				
C-3	R31	RD14BB2B100J	RD	10Ω				
C-2	R32	RD14BB2B220J	RD	22Ω				
C-3	R33	RD14BB2B220J	RD	22Ω				
B-2	R34	RD14BB2B471J	RD	470Ω				
B-2	R35	RD14BB2B471J	RD	470Ω				
B-2	R36	RD14BB2B471J	RD	470Ω				
B-3	R37	RD14BB2B471J	RD	470Ω				
B-3	R38	RD14BB2B471J	RD	470Ω				
B-3	R39	RD14BB2B471J	RD	470Ω				
B-2	R40	RS14AB3D151J	RS	150Ω	±5%	2W		
B-2	R41	RS14AB3D151J	RS	150Ω	±5%	2W		
E-3	R42	RD14BB2B331J	RD	330Ω				
E-3	R43	RN14BK2B5601F	RN	5.6kΩ	±1%	1/8W		
D-3	R44	RN14BK2B4301F	RN	4.3kΩ	±1%	1/8W		
D-3	R45	RN14BK2B1500F	RN	150Ω	±1%	1/8W		
B-3	R46	RS14AB3D151J	RS	150Ω	±5%	2W		
B-3	R47	RS14AB3D151J	RS	150Ω	±5%	2W		
	R48	No use						
E-2	R49	RN14BK2B3300F	RN	330Ω	±1%	1/8W		
	R50	No use						
	R51	No use						
	R52	No use						
	R53	No use						
D-2	R54	RD14BB2B332J	RD	3.3kΩ				
E-3	VR1	R12-0532-05	VR	100Ω B				
E-3	C1	CK45D1H103M	CK	0.01μF	±20%			
	C2	No use						
	C3	CE04W0J102M	CE	1000μF		6.3WV		
C-3	C4	CK45D1H103M	CK	0.01μF	±20%			
D-2	C5	CK45D1H103M	CK	0.01μF	±20%			
	C6	CK45D1H103M	CK	0.01μF	±20%			
C-2	C7	CK45D1H103M	CK	0.01μF	±20%			

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description						Serial No. Eff
C-2	C8	CK45D1H103M	CK			0.01µF	±20%		
C-3	C9	CK45D2H472M	CK			4700pF	±20%	500WV	
E-2	C10	CK45D1H103M	CK			0.01µF	±20%		
E-3	C11	CK45D1H103M	CK			0.01µF	±20%		
D-2	C12	CE04W1J330M	CE			33µF		63WV	
C-2	C13	CK45D2H472M	CK			4700µF	±20%	500WV	
F-3	C14	CE04W1V470M	CE			47µF		35WV	
F-3	C15	CK45D1H103M	CK			0.01µF	±20%		
E-3	C16	CE04W1C470M	CE			47µF		16WV	
E-3	C17	CK45D1H103M	CK			0.01µF	±20%		
	C18	CC45CH1H070D	CC			7pF	±0.5pF		
C-3	C19	CK45D1H152M	CK			1500pF	±20%		
	C20	CC45CH1H100D	CC			10pF	±0.5pF		
	C21	CE04W1C331M	CE			330µF		16WV	
D-2	TC1	C05-0411-05	TC			10pF			
	TC2	No use							
C-2	TC3	C05-0414-05	TC			40pF			
B-2	L1	L40-2282-13	Ferri-inductor			0.22µH			
A-2	L2	L40-2282-13	Ferri-incductor			0.22µH			
A-2	L3	L40-2282-13	Ferri-inductor			0.22µH			
B-3	L4	L40-2282-13	Ferri-inductor			0.22µH			
A-3	L5	L40-2282-13	Ferri-inductor			0.22µH			
A-3	L6	L40-2282-13	Ferri-inductor			0.22µH			
E-2	L7	L40-1011-03	Ferri-inductor			100µH			
E-2	L8	L40-1011-03	Ferri-inductor			100µH			
F-2	L9	L40-1011-03	Ferri-inductor			100µH			
E-2	Q1		TR	NPN	Silicon	2SC2499	For VHF ~ UHF, low noise amp		
E-3	Q2		TR	NPN	Silicon	2SC2499	For VHF ~ UHF, low noise amp		
D-2	Q3		TR	NPN	Silicon	2SC2499	For VHF ~ UHF, low noise amp		
D-3	Q4		TR	NPN	Silicon	2SC2499	For VHF ~ UHF, low noise amp		
D-3	Q5		TR	NPN	Silicon	2SC1047(C)	For high frequency amp		
	Q6	No use							
C-2	Q7		TR	NPN	Silicon	2SC2644	For VHF ~ UHF, wide band amp		
C-3	Q8		TR	NPN	Silicon	2SC2644	For VHF ~ UHF, wide band amp		
C-2	Q9		TR	NPN	Silicon	2SC1164(O)	For high power amp		
C-3	Q10		TR	NPN	Silicon	2SC1164(O)	For high power amp		
D-3	Q11		TR	NPN	Silicon	2SC536KNP(F)	For high frequency amp		
	Q12		TR	NPN	Silicon	2SC536KNP(F)	For high frequency amp		
F-2	P10	E40-0377-05	Pin connector			3P			
F-3	P13	E40-0277-05	Pin connector			2P			
E-2	P20	E40-0576-05	Pin connector			5P			
E-2	P22	E40-0776-05	Pin connector			7P			
		E23-0512-05	Terminal						
		F02-0501-04	Heat sink						
		F02-0502-05	Heat sink						
		L92-0110-05	Core (beads type)						
		J25-2905-02	Printed circuit board						

PARTS LIST

SWEEP ROTARY UNIT X74-1250-00

Fig. & Index No.	Ref. No.	Parts No.	Name & Description						Serial No. Eff
D-2	R1	RN14BK2B6801F	RN			6.8kΩ	±1%	1/8W	
D-2	R2	RN14BK2B2002F	RN			20kΩ	±1%	1/8W	
D-2	R3	RD14BB2B120J	RD			12Ω			
D-2	R4	RD14BB2B471J	RD			470Ω			
D-2	R5	RD14BB2B472J	RD			4.7kΩ			
D-2	R6	RD14BB2B103J	RD			10kΩ			
D-3	R7	RD14BB2E153J	RD		15kΩ	±5%	1/4W		
C-2	R8	RD14BB2B242J	RD			2.4kΩ			
D-2	R9	RD14BB2B203J	RD			20kΩ			
D-2	VR1	R12-1512-05	VR			1kΩB			
C-1	VR2		VR(attached to S1,2,3,4)			5kΩB			
D-2	C1	CE04W1J330M	CE			33μF		63WV	
D-2	C2	CK45D1H103M	CK			0.01μF	±20%		
D-2	C3	CK45D1H103M	CK			0.01μF	±20%		
D-2	C4	CE04W1J4R7M	CE			4.7μF		63WV	
D-3	C5	CE04W1C330M	CE			33μF		16WV	
D-3	C6	CE04W1J330M	CE			33μF		63WV	
C-2	C7	CK45D1H103M	CK			0.01μF	±20%		
B-3	C8	CK45D1H103M	CK			0.01μF	±20%		
B-1	C9	CK45D1H103M	CK			0.01μF	±20%		
B-2	C10	CK45D1H103M	CK			0.01μF	±20%		
C-1	C11	CK45D1H103M	CK			0.01μF	±20%		
D-3	C12	CK45D2H472M	CK			4700pF	±20%	500WV	
D-3	C13	CK45D2H472M	CK			4700pF	±20%	500WV	
D-3	D1		Diode		Zener	WZ-071	7.1V		
D-3	D2		Diode		Silicon	V06C	For rectifier power		
D-2	Q1		TR	NPN	Silicon	2SC536KNP(F)	For high frequency amp		
D-3	Q2		TR	NPN	Silicon	2SD438(F)	For AF power amplifier		
D-3	Q3		TR	NPN	Silicon	2SD438(F)	For AF power amplifier		
D-2	Q4		TR	NPN	Silicon	2SC536KNP(F)	For high frequency amp		
A-2	S1	S02-2501-05	Rotary switch						
B-2	S2	S02-2501-05	Rotary switch						
D-3	S3	S02-2501-05	Rotary switch						
D-3	S4	S02-2501-05	Rotary switch						
B-4	P40	E40-1376-05	Pin connector			13P			
C-4	P41	E40-1376-05	Pin connector			13P			
D-4	P42	E40-0476-05	Pin connector			4P			

PARTS LIST

TRIGGER SWEEP UNIT X74-1220-00

Fig. & Index No.	Ref. No.	Parts No.	Name & Description				Serial No. Eff.	
E-1	R1	RD14BB2B222J	RD	2.2kΩ				
	R2	RD14BB2E220J	RD	22Ω	±5%	1/4W		
E-1	R3	RD14BB2B621J	RD	620Ω				
E-1	R4	RD14BB2B220J	RD	22Ω				
	R5	No use						
G-4	R6	RD14BB2B181J	RD	180Ω				
H-5	R7	RD14BB2B681J	RD	680Ω				
H-5	R8	RD14BB2B220J	RD	22Ω				
H-5	R9	RD14BB2B181J	RD	180Ω				
H-5	R10	RD14BB2B470J	RD	47Ω				
H-5	R11	RD14BB2B511J	RD	510Ω				
E-1	R12	RD14BB2B103J	RD	10kΩ				
D-1	R13	RD14BB2B103J	RD	10kΩ				
E-1	R14	RD14BB2B471J	RD	470Ω				
C-3	R15	RD14BB2B271J	RD	270Ω				
D-1	R16	RD14BB2B561J	RD	560Ω				
D-1	R17	RD14BB2B511J	RD	510Ω				
D-1	R18	RN14BK2B5600F	RN	560Ω	±1%	1/8W		
D-1	R19	RN14BK2B3600F	RN	360Ω	±1%	1/8W		
	R20	No use						
E-1	R21	RD14BB2B104J	RD	100kΩ				
E-1	R22	RD14BB2B104J	RD	100kΩ				
C-1	R23	RD14BB2B562J	RD	5.6kΩ				
C-1	R24	RD14BB2B202J	RD	2kΩ				
C-1	R25	RD14BB2B473J	RD	47kΩ				
C-1	R26	RD14BB2B242J	RD	2.4kΩ				
B-1	R27	RN14BK2E1203F	RN	120kΩ	±1%	1/4W		
B-1	R28	RN14BK2E1203F	RN	120kΩ	±1%	1/4W		
B-1	R29	RN14BK2H3603F	RN	360kΩ	±1%	1/2W		
B-1	R30	RD14BB2B242J	RD	2.4kΩ				
B-1	R31	RD14BB2B682J	RD	6.8kΩ				
B-1	R32	RD14BB2B473J	RD	47kΩ				
B-1	R33	RD14BB2B242J	RD	2.4kΩ				
B-1	R34	RD14BB2B682J	RD	6.8kΩ				
B-1	R35	RD14BB2B473J	RD	47kΩ				
B-1	R36	RD14BB2B682J	RD	6.8kΩ				
B-1	R37	RD14BB2B473J	RD	47kΩ				
B-1	R38	RD14BB2B302J	RD	3kΩ				
B-1	R39	RD14BB2B682J	RD	6.8kΩ				
B-1	R40	RD14BB2B473J	RD	47kΩ				
B-1	R41	RD14BB2B272J	RD	2.7kΩ				
B-1	R42	RN14BK2E1202F	RN	12kΩ	±1%	1/4W		
B-1	R43	RN14BK2E1202F	RN	12kΩ	±1%	1/4W		
B-1	R44	RN14BK2E3602F	RN	36kΩ	±1%	1/4W		
C-1	R45	RD14BB2B272J	RD	2.7kΩ				
B-1	R46	RN14BK2E2401F	RN	2.4kΩ	±1%	1/4W		
B-1	R47	RN14BK2E3601F	RN	3.6kΩ	±1%	1/4W		
B-1	R48	RD14BB2B392J	RD	3.9kΩ				
B-1	R49	RD14BB2B682J	RD	6.8kΩ				
B-1	R50	RD14BB2B473J	RD	47kΩ				
A-2	R51	RD14BB2B223J	RD	22kΩ				
A-2	R52	RD14BB2B104J	RD	100kΩ				
A-2	R53	RD14BB2B104J	RD	100kΩ				
A-2	R54	RD14BB2B223J	RD	22kΩ				
A-2	R55	RD14BB2B223J	RD	22kΩ				
B-2	R56	RD14BB2B104J	RD	100kΩ				
A-2	R57	RD14BB2B104J	RD	100kΩ				
A-2	R58	RD14BB2B223J	RD	22kΩ				
B-2	R59	RD14BB2B104J	RD	100kΩ				
A-2	R60	RD14BB2B223J	RD	22kΩ				
A-2	R61	RD14BB2B223J	RD	22kΩ				
B-2	R62	RD14BB2B104J	RD	100kΩ				
A-2	R63	RD14BB2B104J	RD	100kΩ				
A-2	R64	RD14BB2B223J	RD	22kΩ				

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff.	
B-2	R65	RD14BB2B104J	RD 100kΩ		
A-2	R66	RD14BB2B223J	RD 22kΩ		
A-2	R67	RD14BB2B104J	RD 100kΩ		
A-2	R68	RD14BB2B223J	RD 22kΩ		
C-1	R69	RD14BB2B101J	RD 100Ω		
D-1	R70	RD14BB2B472J	RD 4.7kΩ		
D-1	R71	RD14BB2B432J	RD 4.3kΩ		
D-1	R72	RD14BB2B472J	RD 4.7kΩ		
D-2	R73	RD14BB2B752J	RD 7.5kΩ		
D-2	R74	RD14BB2B221J	RD 220Ω		
D-2	R75	RD14BB2B101J	RD 100Ω		
D-1	R76	RD14BB2B222J	RD 2.2kΩ		
D-1	R77	RD14BB2B101J	RD 100Ω		
D-1	R78	RD14BB2B222J	RD 2.2kΩ		
D-2	R79	RD14BB2B132J	RD 1.3kΩ		
D-2	R80	RD14BB2B472J	RD 4.7kΩ		
D-2	R81	RD14BB2B183J	RD 18kΩ		
D-1	R82	RD14BB2B222J	RD 2.2kΩ		
D-1	R83	RD14BB2B101J	RD 100Ω		
D-2	R84	RD14BB2B222J	RD 2.2kΩ		
D-2	R85	RD14BB2B103J	RD 10kΩ		
D-2	R86	RD14BB2B103J	RD 10kΩ		
D-1	R87	RD14BB2B471J	RD 470Ω		
D-1	R88	RD14BB2B821J	RD 820Ω		
C-2	R89	RD14BB2B392J	RD 3.9kΩ		
C-2	R90	RD14BB2B472J	RD 4.7kΩ		
E-2	R91	RD14BB2B182J	RD 1.8kΩ		
E-2	R92	RD14BB2B222J	RD 2.2kΩ		
E-2	R93	RD14BB2B751J	RD 750Ω		
E-2	R94	RD14BB2B332J	RD 3.3kΩ		
E-1	R95	RN14BK2B3001F	RN 3kΩ ±1% 1/8W		
E-1	R96	RN14BK2B1101F	RN 1.1kΩ ±1% 1/8W		
E-1	R97	RD14BB2B471J	RD 470Ω		
E-1	R98	RD14BB2B103J	RD 10kΩ		
D-1	R99	RD14BB2B152J	RD 1.5kΩ		
H-5	R100	RD14BB2B511J	RD 510Ω		
E-2	R101	RD14BB2B122J	RD 1.2kΩ		
E-2	R102	RD14BB2B220J	RD 22Ω		
E-2	R103	RD14BB2B821J	RD 820Ω		
E-2	R104	RD14BB2B470J	RD 47Ω		
E-2	R105	RD14BB2B331J	RD 330Ω		
E-2	R106	RD14BB2B182J	RD 1.8kΩ		
E-2	R107	RD14BB2B331J	RD 330Ω		
E-3	R108	RD14BB2B103J	RD 10kΩ		
E-1	R109	RD14BB2B471J	RD 470Ω		
C-3	R110	RD14BB2B271J	RD 270Ω		
D-3	R111	RD14BB2B561J	RD 560Ω		
C-3	R112	RD14BB2B511J	RD 510Ω		
C-3	R113	RN14BK2B5600F	RN 560Ω ±1% 1/8W		
D-2	R114	RN14BK2B3600F	RN 360Ω ±1% 1/8W		
	R115	No use			
C-2	R116	RD14BB2B752J	RD 7.5kΩ		
C-2	R117	RD14BB2B203J	RD 20kΩ		
C-2	R118	RD14BB2B562J	RD 5.6kΩ		
C-2	R119	RD14BB2B202J	RD 2kΩ		
C-2	R120	RD14BB2B473J	RD 47kΩ		
C-2	R121	RN14BB2B242J	RD 2.4kΩ		
B-2	R122	RN14BK2E1203F	RN 120kΩ ±1% 1/4W		
B-2	R123	RN14BK2E1203F	RN 120kΩ ±1% 1/4W		
B-2	R124	RN14BK2H3603F	RN 360kΩ ±1% 1/2W		
B-2	R125	RD14BB2B242J	RD 2.4kΩ		
B-2	R126	RD14BB2B682J	RD 6.8kΩ		
B-3	R127	RD14BB2B473J	RD 47kΩ		
B-2	R128	RD14BB2B242J	RD 2.4kΩ		
B-2	R129	RD14BB2B682J	RD 6.8kΩ		
B-3	R130	RD14BB2B473J	RD 47kΩ		

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description				Serial No. Eff.	
B-3	R131	RD14BB2B682J	RD	6.8kΩ				
B-3	R132	RD14BB2B473J	RD	47kΩ				
B-3	R133	RD14BB2B302J	RD	3kΩ				
B-2	R134	RD14BB2B682J	RD	6.8kΩ				
B-3	R135	RD14BB2B473J	RD	47kΩ				
B-2	R136	RD14BB2B272J	RD	2.7kΩ				
B-2	R137	RN14BK2E1202F	RN	12kΩ	±1%	1/4W		
B-2	R138	RN14BK2E1202F	RN	12kΩ	±1%	1/4W		
B-2	R139	RN14BK2E3602F	RN	36kΩ	±1%	1/4W		
B-2	R140	RD14BB2B272J	RD	2.7kΩ				
B-2	R141	RN14BK2E2401F	RN	2.4kΩ	±1%	1/4W		
B-2	R142	RN14BK2E3601F	RN	3.6kΩ	±1%	1/4W		
B-2	R143	RD14BB2B392J	RD	3.9kΩ				
B-3	R144	RD14BB2B682J	RD	6.8kΩ				
B-3	R145	RD14BB2B473J	RD	47kΩ				
B-3	R146	RD14BB2B223J	RD	22kΩ				
B-3	R147	RD14BB2B104J	RD	100kΩ				
B-3	R148	RD14BB2B104J	RD	100kΩ				
B-3	R149	RD14BB2B223J	RD	22kΩ				
B-3	R150	RD14BB2B104J	RD	100kΩ				
B-3	R151	RD14BB2B223J	RD	22kΩ				
B-3	R152	RD14BB2B223J	RD	22kΩ				
B-3	R153	RD14BB2B104J	RD	100kΩ				
B-3	R154	RD14BB2B104J	RD	100kΩ				
B-3	R155	RD14BB2B223J	RD	22kΩ				
A-3	R156	RD14BB2B104J	RD	100kΩ				
A-3	R157	RD14BB2B223J	RD	22kΩ				
A-3	R158	RD14BB2B104J	RD	100kΩ				
A-3	R159	RD14BB2B223J	RD	22kΩ				
C-2	R160	RD14BB2B101J	RD	100Ω				
D-2	R161	RD14BB2B472J	RD	4.7kΩ				
D-2	R162	RD14BB2B432J	RD	4.3kΩ				
D-2	R163	RD14BB2B152J	RD	1.5kΩ				
D-2	R164	RD14BB2B472J	RD	4.7kΩ				
C-3	R165	RD14BB2B752J	RD	7.5kΩ				
C-3	R166	RD14BB2B221J	RD	220Ω				
D-3	R167	RD14BB2B101J	RD	100Ω				
D-3	R168	RD14BB2B222J	RD	2.2kΩ				
	R169	RD14BB2B101J	RD	100Ω				
D-2	R170	RD14BB2B222J	RD	2.2kΩ				
C-3	R171	RD14BB2B622J	RD	6.2kΩ				
C-3	R172	RD14BB2B472J	RD	4.7kΩ				
C-3	R173	RD14BB2B183J	RD	18kΩ				
C-3	R174	RD14BB2B222J	RD	2.2kΩ				
C-3	R175	RD14BB2B101J	RD	100Ω				
D-3	R176	RD14BB2B222J	RD	2.2kΩ				
D-3	R177	RD14BB2B564J	RD	560kΩ				
E-3	R178	RD14BB2B122J	RD	1.2kΩ				
E-3	R179	RD14BB2B751J	RD	750Ω				
E-3	R180	RD14BB2B102J	RD	1kΩ				
E-3	R181	RD14BB2B223J	RD	22kΩ				
F-2	R182	RD14BB2B470J	RD	47Ω				
F-2	R183	RN14BK2B4701F	RN	4.7kΩ	±1%	1/8W		
F-2	R184	RD14BB2B622J	RD	6.2kΩ				
	R185	RN14BK2B2401F	RN	2.4kΩ	±1%	1/8W		
	R186	RN14BK2B1201F	RN	1.2kΩ	±1%	1/8W		
E-3	R187	RN14BK2B2201F	RN	2.2kΩ	±1%	1/8W		
E-3	R188	RN14BK2B2001F	RN	2kΩ	±1%	1/8W		
E-3	R189	RN14BK2B4701F	RN	4.7kΩ	±1%	1/8W		
	R190	RD14BB2B564J	RD	560kΩ				
H-5	R191	RD14BB2B511J	RD	510Ω				
F-3	R192	RD13BB2B472J	RD	4.7kΩ				
E-2	R193	RD14BB2B103J	RD	10kΩ				
D-2	R194	RD14BB2B103J	RD	10kΩ				
E-2	R195	RD14BB2B121J	RD	120Ω				
E-2	R196	RD14BB2B472J	RD	4.7kΩ				

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description				Serial No. Eff.	
F-2	R197	RD14BB2B470J	RD	47Ω				
F-2	R198	RN14BK2B4701F	RN	4.7kΩ	±1%	1/8W		
F-2	R199	RD14BB2B562J	RD	5.6kΩ				
E-2	R200	RN14BK2B2401F	RN	2.4kΩ	±1%	1/8W		
	R201	RN14BK2B1201F	RN	1.2kΩ	±1%	1/8W		
	R202	RD14BB2B392J	RD	3.9kΩ				
E-2	R203	RD14BB2B102J	RD	1kΩ				
E-2	R204	RD14BB2B132J	RD	1.3kΩ				
E-2	R205	RD14BB2B470J	RD	47Ω				
E-2	R206	RD14BB2B332J	RD	3.3kΩ				
	R207	RD14BB2B622J	RD	6.2kΩ				
F-2	R208	RD14BB2B472J	RD	4.7kΩ				
F-2	R209	RD14BB2B472J	RD	4.7kΩ				
E-2	R210	RN14BK2B4700F	RN	470Ω	±1%	1/8W		
E-2	R211	RN14BK2B4700F	RN	470Ω	±1%	1/8W		
E-2	R212	RN14BK2B2201F	RN	2.2kΩ	±1%	1/8W		
F-1	R213	RD14BB2B621J	RD	620Ω				
E-2	R214	RN14BK2B2201F	RN	2.2kΩ	±1%	1/8W		
F-1	R215	RD14BB2B162J	RD	1.6kΩ				
F-2	R216	RD14BB2B162J	RD	1.6kΩ				
E-1	R217	RD14BB2B470J	RD	47Ω				
E-1	R218	RD14BB2B470J	RD	47Ω				
F-1	R219	RD14BB2B102J	RD	1kΩ				
E-1	R220	RD14BB2B102J	RD	1kΩ				
E-1	R221	RN14BK2B1500F	RN	150Ω	±1%	1/8W		
F-1	R222	RD14BB2B102J	RD	1kΩ				
F-1	R223	RD14BB2B102J	RD	1kΩ				
H-5	R224	RD14BB2B220J	RD	22Ω				
I-5	R225	RD14BB2B471J	RD	470Ω				
F-1	R226	RD14BB2B102J	RD	1kΩ				
F-1	R227	RD14BB2B102J	RD	1kΩ				
F-1	R228	RD14BB2B470J	RD	47Ω				
F-1	R229	RD14BB2B470J	RD	47Ω				
F-1	R230	RD14BB2B470J	RD	47Ω				
F-1	R231	RD14BB2B470J	RD	47Ω				
E-3	R232	RD14BB2B472J	RD	4.7kΩ				
E-3	R233	RD14BB2B103J	RD	10kΩ				
E-1	R234	RD14BB2B472J	RD	4.7kΩ				
E-1	R235	RD14BB2B103J	RD	10kΩ				
D-2	R236	RD14BB2B331J	RD	330Ω				
	R237	RD14BB2B682J	RD	6.8kΩ				
	R238	RD14BB2B682J	RD	6.8kΩ				
	R239	No use						
C-3	R240	RD14BB2B100J	RD	10Ω				
D-3	R241	RD14BB2B331J	RD	330Ω				
	R242	No use						
E-3	R243	RD14BB2B222J	RD	2.2kΩ				
	R244	RD14BB2B102J	RD	1kΩ				
	R245	RD14BB2B102J	RD	1kΩ				
	R246	No use						
	R247	RD14BB2B101J	RD	100Ω				
	R248	RD14BB2B222J	RD	2.2kΩ				
	R249	RD14BB2B102J	RD	1kΩ				
	R250	RD14BB2B112J	RD	1.1kΩ				
	R251	RD14BB2B472J	RD	4.7kΩ				
	R252	RD14BB2B220J	RD	22Ω				
	R253	RD14BB2B220J	RD	22Ω				
	R254	No use						
	R255	RD14BB2B152J	RD	1.5kΩ				
	R256	RD14BB2B102J	RD	1kΩ				
	R257	RD14BB2B472J	RD	4.7kΩ				
	R258	RD14BB2B152J	RD	1.5kΩ				
	R259	RD14BB2B102J	RD	1kΩ				
	R260	RD14BB2B102J	RD	1kΩ				
	R261	RD14BB2B470J	RD	47Ω				
I-5	R262	RD14BB2B222J	RD	2.2kΩ				

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff.	
H-5	R263	RD14BB2B470J	RD 47Ω		
H-4	R264	RD14BB2B681J	RD 680Ω		
H-4	R265	RD14BB2B471J	RD 470Ω		
	R266	RD14BB2B470J	RD 47Ω		
	R267	RD14BB2B470J	RD 47Ω		
D-2	VR1	R12-1510-05	VR 1kΩ B		
E-1	VR2	R12-1510-05	VR 1kΩ B		
E-1	VR3	R12-1510-05	VR 1kΩ B		
	VR4	No use			
D-5	VR5	R12-1510-05	VR 1kΩ B		
	VR6	No use			
F-2	VR7	R12-2405-05	VR 5kΩ B		
F-2	VR8	R12-1511-05	VR 1kΩ B		
F-2	VR9	R12-2405-05	VR 2kΩ B		
	VR10	R12-1511-05	VR 1kΩB		
F-2	VR11	R12-2405-05	VR 2kΩ B		
	VR12	R12-0529-05	VR 100Ω B		
	VR13	R12-0531-05	VR 500Ω B		
E-1	C1	C91-0549-05	Tantalum 1μF 35WV		
E-1	C2	C91-0549-05	Tantalum 1μF 35WV		
D-1	C3	C91-0549-05	Tantalum 1μF 35WV		
E-1	C4	CE04W1C220M	CE 22μF 16WV		
D-1	C5	No use			
C-1	C6	C91-0549-05	Tantalum 1μF 35WV		
B-1	C7	CK45D1H103M	CK 0.01μF ±20%		
B-1	C8	CK45D1H103M	CK 0.01μF ±20%		
B-1	C9	CK45D1H103M	CK 0.01μF ±20%		
B-1	C10	CK45D1H103M	CK 0.01μF ±20%		
	C11	CC45CH1H050C	CC 5pF ±0.25pF		
C-1	C12	C91-0547-05	Polyester 10μF ±1% 100WV		
C-1	C13	C91-0548-05	Polyester 1μF ±1% 100WV		
C-1	C14	CQ93BP2A103F	CQ 0.01μF ±1% 10WV		
C-1	C15	CM93BD2A470J	CM 47pF ±5% 100WV		
C-1	C16	CC45CH1H100D	CC 10pF ±0.5pF 50WV		
C-2	C17	CE04W1C101M	CE 100μF 16WV		
B-2	C18	CE04W1C100M	CE 10μF 16WV		
B-2	C19	CE04W1H010M	CE 1μF 50WV		
B-2	C20	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV		
B-2	C21	CK45D1H103M	CK 0.01μF ±20%		
B-2	C22	CK45D1H102M	CK 1000pF ±20%		
D-1	C23	CC45SL1H221J	CC 220pF ±5%		
D-2	C24	No use			
	C25	No use			
C-2	C26	CE04W1C221M	CE 220μF 16WV		
	C27	C90-0298-05	semi-conductor ceramic 0.1μF 12WV		
D-1	C28	CK45D1H103M	CK 0.01μF ±20%		
D-2	C29	CK45D1H103M	CK 0.01μF ±20%		
	C30	CK45D1H103M	CK 0.01μF ±20%		
	C31	No use			
D-2	C32	CC45SL1H221J	CC 220pF ±5%		
E-2	C33	CC45SL1H101J	CC 100pF ±5%		
	C34	No use			
B-2	C35	CK45D1H103M	CK 0.01μF ±20%		
C-2	C36	C91-0549-05	Tantalum 1μF 35WV		
	C37	CK45D1H103M	CK 0.01μF ±20%		
B-2	C38	CK45D1H103M	CK 0.01μF ±20%		
B-2	C39	CK45D1H103M	CK 0.01μF ±20%		
B-2	C40	CK45D1H103M	CK 0.01μF ±20%		
C-2	C41	C91-0548-05	Polyester 1μF ±1% 100WV		
C-3	C42	CQ93BP2A103F	CQ 0.01μF ±1% 100WV		
C-2	C43	CM93BD2A470J	CM 47pF ±5% 100WV		
C-2	C44	CC45CH1H100D	CC 10pF ±0.5pF		
B-3	C45	CE04W1C100M	CE 10μF 16WV		
C-3	C46	CE04W1H010M	CE 1μF 50WV		

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff.	
B-3	C47	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV		
C-3	C48	CK45D1H103M	CK 0.01μF ±20%		
B-3	C49	CK45D1H102M	CK 1000pF ±20%		
D-2	C50	CC45SL1H221J	CC 220pF ±5%		
	C51	No use			
	C52	No use			
	C53	No use			
D-2	C54	CK45D1H103M	CK 0.01μF ±20%		
C-3	C55	CK45D1H103M	CK 0.01μF ±20%		
E-3	C56	CK45D1H103M	CK 0.01μF ±20%		
	C57	No use			
E-2	C58	CK45D1H103M	CK 0.01μF ±20%		
C-2	C59	CE04W1C221M	CE 220μF 16WV		
	C60	No use			
	C61	No use			
	C62	No use			
E-1	C63	No use			
C-1	C64	CE04W1V330M	CE 33μF 35WV		
	C65	No use			
	C66	No use			
E-1	C67	CK45D1H103M	CK 0.01μF ±20%		
E-1	C68	CK45D1H103M	CK 0.01μF ±20%		
F-3	C69	CK45D1H103M	CK 0.01μF ±20%		
F-2	C70	CE04W1C470M	CE 47μF 16WV		
F-3	C71	CK45D1H103M	CK 0.01μF ±20%		
F-3	C72	CE04W1C470M	CE 47μF 16WV		
F-3	C73	CK45D1H103M	CK 0.01μF ±20%		
F-2	C74	CE04W1A101M	CE 100μF 10WV		
F-3	C75	CK45D1H103M	CK 0.01μF ±20%		
F-3	C76	CE04W1V330M	CE 33μF 35WV		
F-3	C77	CK45D2H472M	CK 4700pF ±20% 500WV		
E-3	C78	CK45D2H472M	CK 4700pF ±20% 500WV		
F-1	C79	C91-0549-05	Tantalum 1μF 35WV		
D-1	C80	C91-0549-05	Tantalum 1μF 35WV		
C-3	C81	CK45D1H103M	CK 0.01μF ±20%		
D-1	C82	C91-0549-05	Tantalum 1μF 35WV		
E-1	C83	C91-0549-05	Tantalum 1μF 35WV		
D-2	C84	C91-0549-05	Tantalum 1μF 35WV		
E-2	C85	C91-0549-05	Tantalum 1μF 35WV		
D-3	C86	C91-0549-05	Tantalum 1μF 35WV		
D-3	C87	C91-0549-05	Tantalum 1μF 35WV		
E-3	C88	C91-0549-05	Tantalum 1μF 35WV		
	C89	C91-0549-05	Tantalum 1μF 35WV		
E-3	C90	CK45D1H103M	CK 0.01μF ±20%		
C-3	C91	CE04W1V330M	CE 33μF 35WV		
	C92	No use			
	C93	No use			
	C94	No use			
F-2	C95	CK45D1H103M	CK 0.01μF ±20%		
D-3	C96	C91-0549-05	Tantalum 1μF 35WV		
E-3	C97	CK45D1H103M	CK 0.01μF ±20%		
D-1	C98	C91-0549-05	Tantalum 1μF 35WV		
C-3	C99	CK45D1H103M	CK 0.01μF ±20%		
D-1	C100	C91-0549-05	Tantalum 1μF 35WV		
F-2	C101	CK45D1H103M	CK 0.01μF ±20%		
E-2	C102	CK45D1H103M	CK 0.01μF ±20%		
E-1	C103	C91-0549-05	Tantalum 1μF 35WV		
C-3	C104	C91-0549-05	Tantalum 1μF 35WV		
D-2	C105	C91-0549-05	Tantalum 1μF 35WV		
D-2	C106	C91-0549-05	Tantalum 1μF 35WV		
F-2	C107	C91-0549-05	Tantalum 1μF 35WV		
E-2	C108	C91-0549-05	Tantalum 1μF 35WV		
I-5	C109	CC45CH1H330D	CC 33pF ±0.5pF		
I-5	C110	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV		
	C111	C91-0549-05	Tantalum 1μF 35WV		

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff
	C112	C91-0549-05	Tantalum 1μF 35WV	
	C113	C91-0549-05	Tantalum 1μF 35WV	
	C114	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV	
H-4	C115	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV	
	C116	CC45CH1H070D	CC 7pF ±0.5pF	
	C117	CK45D1H103M	CK 0.01μF ±20%	
	C118	CC45CH1H101J	CC 100pF ±5%	
	C119	CK45D1H103M	CK 0.01μF ±20%	
	C120	CK45D1H103M	CK 0.01μF ±20%	
	C121	CK45D1H103M	CK 0.01μF ±20%	
	C122	CK45D1H103M	CK 0.01μF ±20%	
	C123	CK45D1H103M	CK 0.01μF ±20%	
	C124	CC45SL1H221J	CC 220pF ±5%	
	C125	CC45SL1H221J	CC 220pF ±5%	
	C126	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV	
	C127	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV	
	C128	CE04W1A101M	CE 100μF 10WV	
	C129	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV	
	C130	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV	
C-1	TC1	C05-0030-15	TC 20pF	
D-2	TC2	C05-0062-05	TC 6pF	
	TC3	No use		
C-2	TC4	C05-0030-15	TC 20pF	
C-3	TC5	C05-0062-05	TC 6pF	
	TC6	No use		
	TC7	No use		
	TC8	No use		
	TC9	C05-0062-05	TC 6pF	
	TC10	C05-0062-05	TC 6pF	
F-3	L1	L40-2201-03	Ferri-inductor 22μH	
F-3	L2	L40-2201-03	Ferri-inductor 22μH	
F-3	L3	L40-2201-03	Ferri-inductor 22μH	
F-3	L4	L40-2201-03	Ferri-inductor 22μH	
E-3	L5	L40-2201-03	Ferri-inductor 22μH	
	L6	L40-1001-01	Ferri-inductor 10μH	
	L7	L40-1001-01	Ferri-inductor 10μH	
E-1	D1		Varistor Silicon SV03 For temperature compensating capacitor	
	D2	No use		
	D3	No use		
D-1	D4		Diode Silicon DS442X For switching	
E-1	D5		Diode Silicon DS442X For switching	
D-1	D6		Diode Silicon DS442X For switching	
	D7	No use		
	D8		Diode Silicon DS442X For switching	
	D9	No use		
C-1	D10		Diode Silicon DS442X For switching	
C-1	D11		Diode Silicon DS442X For switching	
C-1	D12		Diode Silicon DS442X For switching	
B-1	D13		Diode Silicon DS442X For switching	
B-1	D14		Diode Silicon DS442X For switching	
B-1	D15		Diode Silicon DS442X For switching	
B-1	D16		Diode Silicon DS442X For switching	
B-1	D17		Diode Silicon DS442X For switching	
B-1	D18		Diode Silicon DS442X For switching	
B-1	D19		Diode Silicon DS442X For switching	
B-1	D20		Diode Silicon DS442X For switching	
B-1	D21		Diode Silicon DS442X For switching	
B-1	D22		Diode Silicon DS442X For switching	
B-1	D23		Diode Silicon DS442X For switching	
A-1	D24		Diode Silicon DS442X For switching	
A-1	D25		Diode Silicon DS442X For switching	
A-1	D26		Diode Silicon DS442X For switching	
A-1	D27		Diode Silicon DS442X For switching	

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff
A-2	D28		Diode Silicon DS442X For switching	
A-2	D29		Diode Silicon DS442X For switching	
A-1	D30		Diode Silicon DS442X For switching	
A-1	D31		Diode Silicon DS442X For switching	
A-1	D32		Diode Silicon DS442X For switching	
A-1	D33		Diode Silicon DS442X For switching	
A-2	D34		Diode Silicon DS442X For switching	
A-2	D35		Diode Silicon DS442X For switching	
A-1	D36		Diode Silicon DS442X For switching	
A-1	D37		Diode Silicon DS442X For switching	
A-1	D38		Diode Silicon DS442X For switching	
A-1	D39		Diode Silicon DS442X For switching	
D-1	D40		Diode Silicon DS442X For switching	
D-1	D41		Diode Silicon DS442X For switching	
D-2	D42		Diode Silicon DS442X For switching	
E-2	D43		Diode Zener WZ-050 5V	
B-1	D44		Diode Silicon DS442X For switching	
	D45		Diode Silicon DS442X For switching	
	D46	No use		
C-2	D47		Diode Silicon DS442X For switching	
C-2	D48		Diode Silicon DS442X For switching	
C-2	D49		Diode Silicon DS442X For switching	
B-2	D50		Diode Silicon DS442X For switching	
B-2	D51		Diode Silicon DS442X For switching	
B-2	D52		Diode Silicon DS442X For switching	
B-2	D53		Diode Silicon DS442X For switching	
B-3	D54		Diode Silicon DS442X For switching	
B-3	D55		Diode Silicon DS442X For switching	
B-2	D56		Diode Silicon DS442X For switching	
B-2	D57		Diode Silicon DS442X For switching	
B-2	D58		Diode Silicon DS442X For switching	
B-3	D59		Diode Silicon DS442X For switching	
A-2	D60		Diode Silicon DS442X For switching	
A-3	D61		Diode Silicon DS442X For switching	
A-3	D62		Diode Silicon DS442X For switching	
A-2	D63		Diode Silicon DS442X For switching	
A-2	D64		Diode Silicon DS442X For switching	
A-3	D65		Diode Silicon DS442X For switching	
A-3	D66		Diode Silicon DS442X For switching	
A-2	D67		Diode Silicon DS442X For switching	
A-2	D68		Diode Silicon DS442X For switching	
A-2	D69		Diode Silicon DS442X For switching	
A-2	D70		Diode Silicon DS442X For switching	
D-2	D71		Diode Silicon DS442X For switching	
	D72		Diode Silicon DS442X For switching	
D-3	D73		Diode Silicon DS442X For switching	
E-2	D74		Diode Silicon DS442X For switching	
D-3	D75		Diode Silicon DS442X For switching	
E-3	D76		Diode Silicon DS442X For switching	
E-3	D77		Diode Silicon DS442X For switching	
E-2	D78		Diode Zener WZ-050 5V	
E-2	D79		Diode Silicon DS442X For switching	
F-1	D80		Varistor Silicon SV05 For temperature compensating capacitor	
C-2	D81		Diode Silicon DS442X For switching	
	D82	No use		
F-1	D83		Varistor Silicon SV05 For temperatire compensating capacitor	
	D84		Diode Zener WZ-120 12V	
E-1	D85		Diode Zener WZ-120 12V	
E-2	D86		Diode Silicon DS442X For switching	
E-3	D87		Diode Silicon DS442X For switching	
	D88	No use		
	D89	No use		
	D90		Diode Silicon DS442X For switching	
	D91		Diode Silicon DS442X For switching	
	D92		Diode Silicon DS442X For switching	
	D93		Diode Silicon DS442X For switching	

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff
	D94		Diode Silicon DS442X For switching	
	D95		Diode Silicon DS442X For switching	
	D96		Diode Silicon DS442X For switching	
	D97		Diode Silicon DS442X For switching	
	D98		Diode Silicon DS442X For switching	
	D99		Diode Silicon DS442X For switching	
	D100		Diode Silicon DS442X For switching	
	D101		Diode Silicon DS442X For switching	
	D102		Diode Silicon DS442X For switching	
	D103		Diode Silicon DS442X For switching	
	D104		Diode Silicon DS442X For switching	
	D105		Diode Silicon DS442X For switching	
H-4	D106		Diode Silicon DS442X For switching	
E-1	Q1		TR PNP Silicon 2SA1161 For high speed switching	
E-1	Q2		TR NPN Silicon 2SC1047(C) For high frequency amp	
E-1	Q3		TR NPN Silicon 2SC1047(C) For high frequency amp	
C-1	Q4		TR NPN Silicon 2SA608KNP(F) For universal	
C-1	Q5		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
C-1	Q6		FET P-channel 2SJ43Q For low frequency amp	
	Q7		TR NPN Silicon 2SC1973(T) For RF amplifier	
B-1	Q8		TR PNP Silicon 2SA608KNP(F) For universal	
B-1	Q9		TR PNP Silicon 2SA608KNP(F) For universal	
B-1	Q10		TR PNP Silicon 2SA608KNP(F) For universal	
B-1	Q11		TR PNP Silicon 2SA608KNP(F) For universal	
B-1	Q12		TR PNP Silicon 2SA608KNP(F) For universal	
C-2	Q13		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
C-2	Q14		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
C-2	Q15		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
C-2	Q16		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
B-2	Q17		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
B-2	Q18		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
B-2	Q19		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
B-2	Q20		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
B-2	Q21		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
D-2	Q22		TR PNP Silicon 2SA608KNP(F) For universal	
D-1	Q23		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
C-1	Q24		FET N-channel 2SK30A(O) For low noise	
C-1	Q25		TR NPN Silicon 2SC1047(C) For high frequency amp	
	Q26		TR NPN Silicon 2SC1047(C) For high frequency amp	
C-1	Q27		TR NPN Silicon 2SC1047(C) For high frequency amp	
D-2	Q28		TR NPN Silicon 2SC1047(C) For high frequency amp	
D-2	Q29		TR PNP Silicon 2SA608KNP(F) For universal	
E-2	Q30		TR NPN Silicon 2SC1047(C) For high frequency amp	
E-2	Q31		TR NPN Silicon 2SC1047(C) For high frequency amp	
E-2	Q32		TR NPN Silicon 2SC1047(C) For high frequency amp	
E-2	Q33		TR PNP Silicon 2SA838(C) For high frequency amp	
C-2	Q34		TR PNP Silicon 2SA608KNP(F) For universal	
B-2	Q35		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
C-2	Q36		FET P-channel 2SJ43Q For low frequency	
	Q37		TR NPN Silicon 2SC1973(T) For RF amplifuer	
B-2	Q38		TR PNP Silicon 2SA608KNP(F) For universal	
B-2	Q39		TR PNP Silicon 2SA608KNP(F) For universal	
B-3	Q40		TR PNP Silicon 2SA608KNP(F) For universal	
B-2	Q41		TR PNP Silicon 2SA608KNP(F) For universal	
B-3	Q42		TR PNP Silicon 2SA608KNP(F) For universal	
C-3	Q43		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
C-3	Q44		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
B-3	Q45		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
B-3	Q46		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
B-3	Q47		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
B-3	Q48		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
B-3	Q49		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
C-3	Q50		TR PNP Silicon 2SA608KNP(F) For universal	
C-3	Q51		TR NPN Silicon 2SC1047(C) For high frequency amp	
C-2	Q52		TR N-channel 2SK30A(O) For low noise	

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff
C-2	Q53		TR NPN Silicon 2SC1047(C) For high frequency amp	
	Q54		TR NPN Silicon 2SC1047(C) For high frequency amp	
C-2	Q55		TR NPN Silicon 2SC1047(C) For high frequency amp	
D-3	Q56		TR NPN Silicon 2SC1047(C) For high frequency amp	
F-2	Q57		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
	Q58		TR NPN Silicon 2SC1047(C) For high frequency amp	
E-2	Q59		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
F-2	Q60		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
E-2	Q61		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
	Q62		TR NPN Silicon 2SC1047(C) For high frequency amp	
E-2	Q63		TR NPN Silicon 2SC1047(C) For high frequency amp	
E-2	Q64		TR NPN Silicon 2SC1047(C) For high frequency amp	
E-2	Q65		TR PNP Silicon 2SA838(C) For high frequency amp	
E-2	Q66		TR NPN Silicon 2SC1047(C) For high frequency amp	
E-2	Q67		TR NPN Silicon 2SC1047(C) For high frequency amp	
E-1	Q68		TR PNP Silicon 2SA838(C) For high frequency amp	
E-1	Q69		TR PNP Silicon 2SA838(C) For high frequency amp	
F-1	Q70		TR NPN Silicon 2SC1047(C) For high frequency amp	
F-1	Q71		TR NPN Silicon 2SC1047(C) For high frequency amp	
E-1	Q72		TR NPN Silicon 2SC1047(C) For high frequency amp	
F-1	Q73		TR NPN Silicon 2SC1047(C) For high frequency amp	
F-1	Q74		TR NPN Silicon 2SC1047(C) For high frequency amp	
F-1	Q75		TR NPN Silicon 2SC1047(C) For high frequency amp	
E-3	Q76		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
E-1	Q77		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
C-2	Q78		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
	Q79		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
H-5	Q80		TR PNP Silicon 2SA1161 For high speed switching	
D-1	IC1		IC Digital 74F00PC	
D-1	IC2		IC Digital SN74S112N	
D-1	IC3		IC Digital SN74S08N	
D-2	IC4		IC Digital SN74S32N	
E-2	IC5		IC Digital SN74S00N	
E-2	IC6		IC Digital 74F00PC	
D-2	IC7		IC Digital SN74S112N	
D-2	IC8		IC Digital SN74S08N	
D-3	IC9		IC Digital SN74S32N	
D-3	IC10		IC Digital SN74S00N	
	IC11		IC Linear TL082CP	
C-2	IC12		IC Linear TL082CP	
G-5	IC13		IC Digital MC10102P	
H-5	IC14		IC Digital MC10135P	
E-2	P13	E40-0276-05	Pin connector 2P	
F-1	P35	E40-0476-05	Pin connector 4P	
	P36	No use		
E-3	P37	E40-0776-05	Pin connector 7P	
	P38	No use		
D-2	P39	E40-0776-05	Pin connector 7P	
A-1	P40	E40-1376-05	Pin connector 13P	
A-2	P41	E40-1376-05	Pin connector 13P	
C-3	P42	E40-0476-05	Pin connector 4P	
F-2	P43	E40-0276-05	Pin connector 2P	
D-2	P44	E40-0276-05	Pin connector 2P	
E-3	P45	E40-0676-05	Pin connector 6P	
D-1	P46	E40-0276-05	Pin connector 2P	
E-3	P47	E40-0476-05	Pin connector 4P	
	P48	No use		
F-3	P49	E40-0676-05	Pin connector 6P	
E-1	P50	E40-0476-05	Pin connector 4P	
	P75	E40-1811-05	Pin connector 18P	
		J21-2905-04	Bracket (for P.C. board)	
		J25-2913-02	Printed circuit board	

PARTS LIST

HORIZONTAL OUTPUT AMPLIFIER UNIT X74-1230-00

Fig. & Index No	Ref. No.	Parts No.	Name & Description				Serial No. Eff.	
B-1	R1	RD14BB2B272J	RD	2.7kΩ				
B-1	R2	RD14BB2B272J	RD	2.7kΩ				
B-1	R3	RD14BB2B470J	RD	47Ω				
B-2	R4	RD14BB2B470J	RD	47Ω				
B-1	R5	RD14BB2B152J	RD	1.5kΩ				
B-1	R6	RD14BB2B183J	RD	18kΩ				
B-2	R7	RD14BB2B183J	RD	18kΩ				
C-2	R8	RD14BB2B821J	RD	820Ω				
C-2	R9	RD14BB2B821J	RD	820Ω				
D-2	R10	RD14BB2B102J	RD	1kΩ				
D-2	R11	RD14BB2B102J	RD	1kΩ				
	R12	No use						
	R13	No use						
C-1	R14	RS14GB3A223J	RD	22kΩ	±5%	1W		
C-3	R15	RS14GB3A223J	RD	22kΩ	±5%	1W		
D-1	R16	RD14BB2B134J	RD	130kΩ				
D-3	R17	RD14BB2B134J	RD	130kΩ				
E-2	R18	RD14BY2H123J	RD	12kΩ	±5%	1/2W		
E-2	R19	RD14BB2B102J	RD	1kΩ				
E-2	R20	RD14BB2B102J	RD	1kΩ				
E-1	R21	RD14BB2B220J	RD	22Ω				
E-3	R22	RD14BB2B220J	RD	22Ω				
F-2	R23	RD14BB2B471J	RD	470Ω				
F-2	R24	RD14BB2B471J	RD	470Ω				
B-2	R25	RD14BB2B471J	RD	470Ω				
B-2	R26	RD14BB2B472J	RD	4.7kΩ				
B-2	R27	RD14BB2B472J	RD	4.7kΩ				
C-2	R28	RD14BB2B271J	RD	270Ω				
C-2	R29	RD14BB2B512J	RD	5.1kΩ				
B-1	C1	CK45D2H472M	CK	4700pF	±20%	500WV		
C-1	C2	CK45D1H103M	CK	0.01μF	±20%			
	C3	No use						
	C4	No use						
C-2	C5	CK45D1H103M	CK	0.01μF	±20%			
C-2	C6	CK45D1H103M	CK	0.01μF	±20%			
	C7	No use						
	C8	No use						
C-3	C9	CK45D1H103M	CK	0.01μF	±20%			
C-1	C10	CC45CH2H010C	CC	1pF	±0.25pF	500WV		
D-1	C11	CC45CH2H010C	CC	1pF	±0.25pF	500WV		
C-3	C12	CC45CH2H010C	CC	1pF	±0.25pF	500WV		
D-3	C13	CC45CH2H010C	CC	1pF	±0.25pF	500WV		
C-2	C14	CK45D1H103M	CK	0.01μF	±20%			
E-2	C15	CK45D2H472M	CK	4700pF	±20%	500WV		
E-2	C16	CK45D2H472M	CK	4700pF	±20%	500WV		
D-2	C17	CK45D2H472M	CK	4700pF	±20%	500WV		
F-2	C18	C91-0549-05	Tantalum	1μF		35WV		
E-2	C19	CK45D1H103M	CK	0.01μF	±20%			
F-2	C20	C91-0549-05	Tantalum	1μF		35WV		
F-2	C21	CK45D2H472M	CK	4700pF	±20%	500WV		
B-2	C22	CK45D1H103M	CK	0.01μF	±20%			
B-3	C23	CE04W1C101M	CE	100μF		16WV		
B-3	C24	CE04W1C101M	CE	100μF		16WV		
	C25	No use						
B-3	C26	CE04W2A100M	CE	10μF		100WV		
B-3	C27	CE04W2C2R2M	CE	2.2μF		160WV		
C-2	C28	CK45D1H103M	CK	0.01μF	±20%			
	C29	CC45CH1H070D	CC	7pF	±0.5pF			
B-3	L1	L40-1011-04	Ferri-inductor	100μH				
B-3	L2	L40-1011-04	Ferri-inductor	100μH				

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff
	L3	No use		
A-3	L4	L40-1011-04	Ferri-inductor 100μH	
A-3	L5	L40-1011-04	Ferri-inductor 100μH	
	D1	No use		
	D2	No use		
	D3	No use		
	D4	No use		
	D5	No use		
	D6	No use		
	D7	No use		
	D8	No use		
E-2	D9		Diode Silicon DS442X For switching	
E-2	D10		Diode Silicon DS442X For switching	
E-2	D11		Diode Silicon DS442X For switching	
	D12	No use		
F-2	D13		Diode Zener WZ-050 5V	
B-1	Q1		TR PNP Silicon 2SA838(C) For high frequency, small signal	
B-2	Q2		TR PNP Silicon 2SA838(C) For high frequency, small signal	
	Q3	No use		
	Q4	No use		
C-2	Q5		TR PNP Silicon 2SA838(C) For high frequency, small signal	
C-2	Q6		TR PNP Silicon 2SA838(C) For high frequency, small signal	
D-1	Q7		TR NPN Silicon 2SC805A-2(2,3) For high speed switching	
D-3	Q8		TR NPN Silicon 2SC805A-2(2,3) For high speed switching	
E-1	Q9		TR PNP Silicon 2SA923-2(2,3) For high speed switching	
E-3	Q10		TR PNP Silicon 2SA923-2(2,3) For high speed switching	
C-2	Q11		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
C-2	Q12		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
	Q13		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
		E-31-0747-05	Lead wire with connector	
B-2	P27	E40-0876	Pin connector 8P	
B-1	P35	E40-0476-05	Pin connector 4P	
B-1	P36	E40-0676-05	Pin connector 6P	
		F01-0827-04	Heat sink	
		J25-2907-04	Printed circuit board	
		J25-2913-02	Printed circuit board	
		J30-0605-05	Spacer (for TR)	

PARTS LIST

HORIZONTAL MODE CONTROL UNIT X77-1130-00

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff.	
B-1	R1	RD14BB2B393J	RD 39kΩ		
B-1	R2	RD14BB2B393J	RD 39kΩ		
B-1	R3	RD14BB2B393J	RD 39kΩ		
B-1	R4	RD14BB2B393J	RD 39kΩ		
B-1	R5	RD14BB2B393J	RD 39kΩ		
B-1	R6	RD14BB2B393J	RD 39kΩ		
B-2	R7	RD14BB2B824J	RD 820kΩ		
B-1	R8	RD14BB2B393J	RD 39kΩ		
B-2	R9	RD14BB2B824J	RD 820kΩ		
B-1	R10	RD14BB2B393J	RD 39kΩ		
B-2	R11	RD14BB2B824J	RD 820kΩ		
B-1	R12	RD14BB2B393J	RD 39kΩ		
B-1	R13	RD14BB2B473J	RD 47kΩ		
B-1	R14	RD14BB2B473J	RD 47kΩ		
B-1	R15	RD14BB2B184J	RD 180kΩ		
C-1	R16	RD14BB2B391J	RD 390Ω		
C-1	R17	RD14BB2B391J	RD 390Ω		
C-1	R18	RD14BB2B391J	RD 390Ω		
C-1	R19	RD14BB2B391J	RD 390Ω		
C-1	R20	RD14BB2B391J	RD 390Ω		
C-1	R21	RD14BB2B391J	RD 390Ω		
C-2	R22	RD14BB2B393J	RD 39kΩ		
C-2	R23	RD14BB2B393J	RD 39kΩ		
C-2	R24	RD14BB2B393J	RD 39kΩ		
C-2	R25	RD14BB2B393J	RD 39kΩ		
B-2	R26	RD14BB2B824J	RD 820kΩ		
B-2	R27	RD14BB2B393J	RD 39kΩ		
A-2	R28	RD14BB2B824J	RD 820kΩ		
B-2	R29	RD14BB2B393J	RD 39kΩ		
B-2	R30	RD14BB2B824J	RD 820kΩ		
B-2	R31	RD14BB2B393J	RD 39kΩ		
B-1	R32	RD14BB2B473J	RD 47kΩ		
B-1	R33	RD14BB2B473J	RD 47kΩ		
B-1	R34	RD14BB2B184J	RD 180kΩ		
C-2	R35	RD14BB2B391J	RD 390Ω		
C-2	R36	RD14BB2B391J	RD 390Ω		
C-2	R37	RD14BB2B391J	RD 390Ω		
C-2	R38	RD14BB2B562J	RD 5.6kΩ		
C-2	R39	RD14BB2B562J	RD 5.6kΩ		
C-2	R40	RD14BB2B562J	RD 5.6kΩ		
C-2	R41	RD14BB2B184J	RD 180kΩ		
C-1	R42	RD14BB2B223J	RD 22kΩ		
D-1	R43	RD14BB2B473J	RD 47kΩ		
D-1	R44	RD14BB2B103J	RD 10kΩ		
D-2	R45	RD14BB2B472J	RD 4.7kΩ		
D-2	R46	RD14BB2B332J	RD 3.3kΩ		
D-2	R47	RD14BB2B272J	RD 2.7kΩ		
D-2	R48	RD14BB2B331J	RD 330Ω		
C-2	R49	RD14BB2B561J	RD 560Ω		
D-2	R50	RD14BB2B272J	RD 2.7kΩ		
D-2	R51	RD14BB2B153J	RD 15kΩ		
C-3	R52	RD14BB2B103J	RD 10kΩ		
C-2	R53	RD14BB2B102J	RD 1kΩ		
C-3	R54	RD14BB2B102J	RD 1kΩ		
C-3	R55	RD14BB2B103J	RD 10kΩ		
D-3	R56	RD14BB2B103J	RD 10kΩ		
E-2	R57	RD14BB2B181J	RD 180Ω		
D-2	R58	RD14BB2B103J	RD 10kΩ		
D-2	R59	RD14BB2B392J	RD 3.9kΩ		
	R60	No use			
	R61	No use			
D-2	R62	RD14BB2B103J	RD 10kΩ		
D-2	R63	RD14BB2B103J	RD 10kΩ		
F-2	R64	RD14BB2B220J	RD 22Ω		

PARTS LIST

Fig. & Index No	Ref. No.	Parts No.	Name & Description	Serial No. Eff.	
F-2	R65	RD14BB2B272J	RD 2.7kΩ		
F-3	R66	RD14BB2B470J	RD 47Ω		
E-2	R67	RD14BB2B220J	RD 22Ω		
F-2	R68	RD14BB2B272J	RD 2.7kΩ		
E-3	R69	RD14BB2B470J	RD 47Ω		
E-1	R70	RN14BK2B3600F	RN 360Ω ±1% 1/8W		
E-1	R71	RN14BK2B30R0F	RN 30Ω ±1% 1/8W		
	R72	No use			
E-1	R73	RD14BB2B223J	RD 22kΩ		
E-1	R74	RD14BB2B103J	RD 10kΩ		
E-1	R75	RD14BB2B103J	RD 10kΩ		
E-1	R76	RN14BK2B1003F	RN 100kΩ ±1% 1/8W		
E-1	R77	RN14BK2B9102F	RN 91kΩ ±1% 1/8W		
E-1	R78	RD14BB2B472J	RD 4.7kΩ		
A-3	R79	RD14BB2E470J	RD 47Ω ±5% 1/4W		
B-3	R80	RN14BK2H9003F	RN 900kΩ ±1% 1/2W		
B-3	R81	RN14BK2E1113F	RN 111kΩ ±1% 1/4W		
B-3	R82	RD14BB2B680J	RD 68Ω		
B-3	R83	RN14BK2H1004F	RN 1MΩ ±1% 1/2W		
	R84	RD14BB2B104J	RD 100kΩ		
B-2	R85	RD14BB2B101J	RD 100Ω		
B-2	R86	RN14BK2B2701F	RN 2.7kΩ ±1% 1/8W		
B-2	R87	RN14BK2B2701F	RN 2.7kΩ ±1% 1/8W		
B-2	R88	RD14BB2B220J	RD 22Ω		
B-2	R89	RD14BB2B220J	RD 22Ω		
B-2	R90	RD14BB2B220J	RD 22Ω		
B-2	R91	RN14BK2B8200F	RN 820Ω ±1% 1/8W		
B-2	R92	RN14BK2B8200F	RN 820Ω ±1% 1/8W		
B-2	R93	RD14BB2B220J	RD 22Ω		
A-2	R94	RN14BK2B39R0F	RN 39Ω ±1% 1/8W		
A-2	R95	RN14BK2B39R0F	RN 39Ω ±1% 1/8W		
A-2	R96	RD14BB2B122J	RD 1.2kΩ		
C-3	R97	RD14BB2E470J	RD 47Ω ±5% 1/4W		
B-3	R98	RN14BK2H9003F	RN 900kΩ ±1% 1/2W		
B-3	R99	RN14BK2E1113F	RN 111kΩ ±1% 1/4W		
B-3	R100	RD14BB2B680J	RD 68Ω		
C-3	R101	RN14BK2H1004F	RN 1MΩ ±1% 1/2W		
C-2	R102	RD14BB2B104J	RD 100kΩ		
B-2	R103	RD14BB2B101J	RD 100Ω		
B-2	R104	RN14BK2B2701F	RN 2.7kΩ ±1% 1/8W		
B-2	R105	RN14BK2B2701F	RN 2.7kΩ ±1% 1/8W		
B-2	R106	RD14BB2B220J	RD 22Ω		
B-2	R107	RD14BB2B220J	RD 22Ω		
B-2	R108	RD14BB2B220J	RD 22Ω		
B-2	R109	RN14BK2B8200F	RN 820Ω ±1% 1/8W		
B-2	R110	RN14BK2B8200F	RN 820Ω ±1% 1/8W		
B-2	R111	RD14BB2B220J	RD 22Ω		
C-2	R112	RN14BK2B39R0F	RN 39Ω ±1% 1/8W		
C-2	R113	RN14BK2B39R0F	RN 39Ω ±1% 1/8W		
C-2	R114	RD14BB2B122J	RD 1.2kΩ		
D-3	R115	RD14BB2B221J	RD 220Ω		
E-1	VR1	R12-0533-05	VR 200ΩB		
E-1	VR2	R12-5512-05	VR 100kΩ B		
B-3	VR3	R12-0533-05	VR 200Ω B		
B-3	VR4	R12-0533-05	VR 200Ω B		
B-1	C1	CC45SL1H101J	CC 100pF ±5%		
A-1	C2	CC45SL1H101J	CC 100pF ±5%		
A-1	C3	CC45SL1H101J	CC 100pF ±5%		
A-1	C4	CC45SL1H101J	CC 100pF ±5%		
B-1	C5	CC45SL1H101J	CC 100pF ±5%		
B-1	C6	CC45SL1H101J	CC 100pF ±5%		

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description					Serial No. Eff
B-1	C7	CK45D1H103M	CK		0.01μF	±20%		
C-2	C8	CC45SL1H101J	CC		100pF	±5%		
C-2	C9	CC45SL1H101J	CC		100pF	±5%		
C-2	C10	CC45SL1H101J	CC		100pF	±5%		
C-2	C11	CC45SL1H101J	CC		100pF	±5%		
B-1	C12	CK45D1H103M	CK		0.01μF	±20%		
E-2	C13	CK45D1H103M	CK		0.01μF	±20%		
D-1	C14	CK45D1H103M	CK		0.01μF	±20%		
D-1	C15	CE04W1C471M	CE		470μF		16WV	
D-3	C16	C91-0549-05	Tantalum		1μF		35WV	
D-3	C17	C91-0549-05	Tantalum		1μF		35WV	
C-3	C18	CM93BD2A331J	CM		330pF	±5%	100WV	
C-3	C19	CM93BD2A331J	CM		330pF	±5%	100WV	
	C20	No use						
C-2	C21	CC45SL1H681J	CC		680pF	±5%		
	C22	CC45SL1H471J	CC		470pF	±5%		
E-3	C23	CK45D1H103M	CK		0.01μF	±20%		
E-2	C24	C91-0549-05	Tantalum		1μF		35WV	
E-3	C25	C91-0549-05	Tantalum		1μF		35WV	
E-1	C26	CE04W1C471M	CE		470μF		16WV	
E-1	C27	CQ93BP2A472F	CQ		4700pF	±1%	100WV	
E-1	C28	CQ93BP2A472F	CQ		4700pF	±1%	100WV	
	C29	CC45CH1H270J	CC		27pF	±5%		
B-2	C30	C91-0501-05	Metalized film		0.047pF		630WV	
B-3	C31	CK45D1H103M	CK		0.01μF	±20%		
B-2	C32	CK45D1H103M	CK		0.01μF	±20%		
A-2	C33	CK45D1H103M	CK		0.01μF	±20%		
B-3	C34	CK45D1H103M	CK		0.01μF	±20%		
B-3	C35	CC45CH1H270J	CC		27pF	±5%		
B-1	C36	C91-0501-05	Metalized film		0.047pF		630WV	
C-2	C37	CK45D1H103M	CK		0.01μF	±20%		
E-2	C38	CE04W1C471M	CE		470μF		16WV	
E-1	C39	CK45D1H103M	CK		0.01μF	±20%		
E-2	C40	CK45D1H103M	CK		0.01μF	±20%		
E-2	C41	CE04W1C471M	CE		470μF		16WV	
E-2	C42	CK45D1H103M	CK		0.01μF	±20%		
F-2	C43	CE04W1C471M	CE		470μF		16WV	
E-2	C44	CK45D1H103M	CK		0.01μF	±20%		
F-2	C45	CE04W1C471M	CE		470μF		16WV	
E-3	C46	CC45SL1H680J	CC		68pF	±5%		
	C47	CC45CH1H100D	CC		10pF	±0.5pF		
	C48	CC45CH1H100D	CC		10pF	±0.5pF		
B-3	TC1	C05-0411-05	TC		10pF			
B-3	TC2	C05-0411-05	TC		10pF			
B-3	TC3	C05-0410-05	TC		6pF			
C-3	TC4	C05-0411-05	TC		10pF			
B-3	TC5	C05-0411-05	TC		10pF			
B-3	TC6	C05-0410-05	TC		6pF			
E-1	L1	L40-4701-03	Ferri-inductor		47μH			
F-1	L2	L40-1011-04	Ferri-inductor		100μH			
E-1	L3	L40-4701-03	Ferri-inductor		47μH			
F-1	L4	L40-1011-03	Ferri-inductor		100μH			
F-1	L5	L40-1011-03	Ferri-inductor		100μH			
B-1	D1		Diode	Silicon	DS442X	For switching		
B-1	D2		Diode	Silicon	DS442X	For switching		
B-1	D3		Diode	Silicon	DS442X	For switching		
B-1	D4		Diode	Silicon	DS442X	For switching		
B-1	D5		Diode	Silicon	DS442X	For switching		
B-1	D6		Diode	Silicon	DS442X	For switching		
A-1	D7		Diode	Silicon	DS442X	For switching		
A-1	D8		Diode	Silicon	DS442X	For switching		
B-1	D9		Diode	Silicon	DS442X	For switching		

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff
B-1	D10		Diode Silicon DS442X For switching	
B-1	D11		Diode Silicon DS442X For switching	
B-1	D12		Diode Silicon DS442X For switching	
C-2	D13		Diode Silicon DS442X For switching	
C-2	D14		Diode Silicon DS442X For switching	
C-2	D15		Diode Silicon DS442X For switching	
C-2	D16		Diode Silicon DS442X For switching	
B-1	D17		Diode Silicon DS442X For switching	
B-1	D18		Diode Silicon DS442X For switching	
D-1	D19		Diode Silicon DS442X For switching	
D-1	D20		Diode Silicon DS442X For switching	
D-2	D21		Diode Silicon DS442X For switching	
D-2	D22		Diode Silicon DS442X For switching	
D-2	D23		Diode Silicon DS442X For switching	
D-2	D24		Diode Silicon DS442X For switching	
C-2	D25		Diode Silicon DS442X For switching	
C-3	D26		Diode Silicon DS442X For switching	
E-3	D27		Diode Silicon DS442X For switching	
E-3	D28		Diode Silicon DS442X For switching	
E-3	D29		Diode Silicon DS442X For switching	
D-3	D30		Diode Silicon DS442X For switching	
	D31	No use		
E-2	D32		Diode Silicon DS442X For switching	
E-2	D33		Diode Silicon DS442X For switching	
E-2	D34		Diode Silicon DS442X For switching	
E-2	D35		Diode Silicon DS442X For switching	
D-2	D36		Diode Silicon DS442X For switching	
	D37	No use		
E-1	D38		Diode Germanium 1N60 For small signal	
E-1	D39		Diode Silicon DS442X For switching	
E-1	D40		Diode Silicon DS442X For switching	
B-2	D41		Diode Silicon 1S1544A For switching	
B-2	D42		Diode Silicon DS442X For switching	
B-2	D43		Diode Silicon DS442X For switching	
B-2	D44		Diode Silicon DS442X For switching	
B-2	D45		Diode Silicon DS442X For switching	
A-3	D46		Diode Silicon DS442X For switching	
B-2	D47		Diode Silicon 1S1544A For switching	
C-2	D48		Diode Silicon DS442X For switching	
C-2	D49		Diode Silicon DS442X For switching	
C-2	D50		Diode Silicon DS442X For switching	
C-2	D51		Diode Silicon DS442X For switching	
C-3	D52		Diode Silicon DS442X For switching	
B-2	D53		Diode Silicon DS442X For switching	
B-2	D54		Diode Silicon DS442X For switching	
C-2	Q1		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
C-2	Q2		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
C-2	Q3		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
D-1	Q4		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
D-2	Q5		TR PNP Silicon 2SA608KNP(F) For universal	
D-2	Q6		TR PNP Silicon 2SA608KNP(F) For universal	
D-2	Q7		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
F-2	Q8		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
E-2	Q9		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
E-1	Q10		TR PNP Silicon 2SA608KNP(F) For universal	
E-1	Q11		TR PNP Silicon 2SA608KNP(F) For universal	
E-1	Q12		TR PNP Silicon 2SA608KNP(F) For universal	
B-2	Q13		FET Dual N-channel U440 For VHF ~ UHF	
B-2	Q14		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
B-2	Q15		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
A-2	Q16		TR NPN Silicon 2SD438(F) For AF power amplifier	
B-2	Q17		FET Dual N-channel U440 For VHF ~ UHF	
B-2	Q18		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
B-2	Q19		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
C-20	Q20		TR NPN Silicon 2SD438(F) For AF power amplifier	

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff
B-2	IC1		IC Digital MC14584BCP	
C-1	IC2		IC Digital MC14069UBCP	
C-2	IC3		IC Digital MC14001BCP	
C-1	IC4		IC Digital MC14174BCP	
D-1	IC5		IC Digital MC14503BCP	
D-2	IC6		IC Digital SN7442AN	
C-2	IC7		IC Digital MC14013BCP	
D-2	IC8		IC Digital MC14011BCP	
E-2	IC9		IC Digital SN74LS04N	
D-2	IC10		IC Digital SN74LS08N	
D-3	IC11		IC Digital SN74S112N	
E-3	IC12		IC Digital SN74LS51N	
E-2	IC13		IC Digital SN74LS04N	
E-2	IC14		IC Digital SN74LS08N	
E-3	IC15		IC Digital SN74S00N	
D-3	IC16		IC Digital SN74LS00N	
E-2	IC17		IC Linear FS7805L	
C-1	TP1	E23-0508-04	Test Pin	
E-1	TP2	E40-0211-05	Test Pin	
D-1	P6	E40-0576-05	Pin connector 5P	
A-2	P11	E40-0477-05	Pin connector 4P	
C-2	P12	E40-0476-05	Pin connector 4P	
E-3	P14	E40-0776-05	Pin connector 7P	
E-3	P28	E40-0476-05	Pin connector 4P	
F-1	P36	E40-0676-05	Pin connector 6P	
D-3	P48	E40-1811-05	Pin connector 18P	
F-1	P49	E40-0676-05	Pin connector 6P	
E-1	P52	E40-0276-05	Pin connector 2P	
E-1	P53	E40-0276-05	Pin connector 2P	
C-3	P54	E40-1211-05	Pin connector 12P	
B-1	P55	E40-1511-05	Pin connector 15P	
A-3	P56	E40-0277-05	Pin connector 2P	
B-2	RL1	S51-2502-05	Relay	
C-3	RL2	S51-2502-05	Relay	
		W09-0016-05	Lithum battery	
		J21-2904-14	Bracket	
		J25-2905-02	Printed circuit board	

PARTS LIST

A TRIGGER SWITCH UNIT X77-1110-00

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff.	
B-1	R1	RD14BB2B510J	RD 51Ω		
B-1	R2	RD14BB2B101J	RD 100Ω		
B-2	R3	RD14BB2B101J	RD 100Ω		
A-2	R4	RD14BB2B510J	RD 51Ω		
B-1	R5	RD14BB2B101J	RD 100Ω		
C-1	R6	RD14BB2B103J	RD 10kΩ		
	R7	RD14BB2B473J	RD 47kΩ		
B-3	R8	RD14BB2B473J	RD 47kΩ		
	R9	RN14BK2B4702F	RN 47kΩ ±1% 1/8W		
C-4	R10	RN14BK2B1003F	RN 100kΩ ±1% 1/8W		
C-4	R11	RN14BK2B1003F	RN 100kΩ ±1% 1/8W		
C-4	R12	RN14BK2B4702F	RN 47kΩ ±1% 1/8W		
B-4	R13	RD14BB2B103J	RD 10kΩ		
B-4	R14	RD14BB2B103J	RD 10kΩ		
C-3	R15	RD14BB2B471J	RD 470Ω		
	R16	No use			
C-2	R17	RD14BB2B123J	RD 12kΩ		
C-2	R18	RD14BB2B103J	RD 10kΩ		
C-2	R19	RD14BB2B103J	RD 10kΩ		
D-1	R20	RD14BB2B473J	RD 47kΩ		
D-1	R21	RD14BB2B223J	RD 22kΩ		
C-3	R22	RD14BB2B220J	RD 22Ω		
C-3	R23	RD14BB2B101J	RD 100Ω		
C-3	R24	RD14BB2E105J	RD 1MΩ ±5% 1/4W		
D-3	R25	RD14BB2E105J	RD 1MΩ ±5% 1/4W		
D-3	R26	RN14BK2B3001F	RN 3kΩ ±1% 1/8W		
D-3	R27	RN14BK2B3001F	RN 3kΩ ±1% 1/8W		
D-3	R28	RD14BB2B220J	RD 22Ω		
D-3	R29	RD14BB2B220J	RD 22Ω		
D-3	R30	RD14BB2B562J	RD 5.6kΩ		
D-3	R31	RD14BB2B562J	RD 5.6kΩ		
D-3	R32	RN14BK2B2200F	RN 220Ω ±1% 1/8W		
D-3	R33	RN14BK2B2200F	RN 220Ω ±1% 1/8W		
C-1	R34	RN14BK2B1501F	RN 1.5kΩ ±1% 1/8W		
E-2	R35	RN14BK2B1501F	RN 1.5kΩ ±1% 1/8W		
C-1	R36	RN14BK2B7500F	RN 750Ω ±1% 1/8W		
C-1	R37	RN14BK2B2700F	RN 270Ω ±1% 1/8W		
E-2	R38	RN14BK2B2700F	RN 270Ω ±1% 1/8W		
C-1	R39	RD14BB2B220J	RD 22Ω		
C-1	R40	RD14BB2B220J	RD 22Ω		
E-2	R41	No use			
E-1	R42	RD14BB2B680J	RD 68Ω		
E-2	R43	RD14BB2B680J	RD 68Ω		
E-2	R44	No use			
E-2	R45	No use			
D-1	R46	RD14BB2B220J	RD 22Ω		
D-2	R47	RD14BB2B220J	RD 22Ω		
D-2	R48	RD14BB2B473J	RD 47kΩ		
D-2	R49	RD14BB2B473J	RD 47kΩ		
D-2	R50	RD14BB2B220J	RD 22Ω		
D-2	R51	RD14BB2B220J	RD 22Ω		
D-2	R52	RD14BB2B271J	RD 270Ω		
D-2	R53	RD14BB2B271J	RD 270Ω		
D-2	R54	RD14BB2B102J	RD 1kΩ		
C-2	R55	RD14BB2B220J	RD 22Ω		
C-2	R56	RD14BB2B470J	RD 47Ω		
	R57	No use			
	R58	RD14BB2B103J	RD 10kΩ		
	R59	RD14BB2B243J	RD 24kΩ		
	R60	RD14BB2B363J	RD 36kΩ		
B-3	VR1	R01-2510-05	VR (attached S3a, b, 4) 5kΩ B		
B-3	VR2	R12-3516-05	VR 10kΩ B		
B-4	VR3	R12-0532-05	VR 100ΩB		

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff
B-1	C1	C91-0502-05	Metalized film 0.01μF 630WV	
B-3	C2	CC45CH1H680J	CC 68pF ±5%	
B-3	C3	CC45CH1H680J	CC 68pF ±5%	
C-4	C4	CE04BW1E100M	CE 10μF 25WV	
	C5	CE04BW1E100M	CE 10μF 25WV	
C-3	C6	CK45D1H103M	CK 0.01μF +20%	
C-2	C7	CE04W1H3R3M	CE 3.3μF 50WV	
C-2	C8	C90-0298-05	Semi-conductor ceramic 0.1μF 12WV	
D-3	C9	CC45CH1H220J	CC 22pF ±5%	
D-3	C10	CC45CH1H220J	CC 22pF ±5%	
E-1	C11	No use		
E-1	C12	No use		
D-2	C13	CC45CH1H220J	CC 22pF ±5%	
D-4	C14	CK45D1H103M	CK 0.01μF ±20%	
B-3	C15	C91-0549-05	Tantalum 1μF 35WV	
D-4	C16	CE04W1C330M	CE 33μF 16WV	
D-4	C17	CE04W1C330M	CE 33μF 16WV	
D-4	C18	CK45D1H103M	CK 0.01μF ±20%	
D-3	C19	CK45D1H103M	CK 0.01μF ±20%	
D-1	C20	CK45D1H103M	CK 0.01μF ±20%	
E-1	C21	CK45D1H103M	CK 0.01μF ±20%	
D-3	C22	CK45D1H103M	CK 0.01μF ±20%	
B-4	C23	C91-0549-05	Tantalum 1μF 35WV	
E-4	C24	CE04W1C330M	CE 33μF 16WV	
E-3	C25	CE04W1C330M	CE 33μF 16WV	
C-2	C26	CK45D1H103M	CK 0.01μF ±20%	
D-2	C27	CK45D1H103M	CK 0.01μF ±20%	
E-2	C28	CK45D1H103M	CK 0.01μF ±20%	
	C29	No use		
	C30	CK45D1H103M	CK 0.01μF ±20%	
	C31	CK45D1H103M	CK 0.01μF ±20%	
E-2	TC1	C05-0412-05	TC 20pF	
D-3	L1	L40-2201-03	Ferri-inductor 22μH	
E-3	L2	L40-2201-03	Ferri-inductor 22μH	
C-2	D1		Diode Silicon DS442X For switching	
	D2		Diode Silicon DS442X For switching	
	D3		Diode Silicon DS442X For switching	
	D4		Diode Silicon DS442X For switching	
	D5		Diode Silicon DS442X For switching	
	D6		Diode Silicon DS442X For switching	
C-4	Q1		FET P-channel 2SJ43(Q) For low noise	
C-4	Q2		FET N-channel 2SK127(Q) For low frequency	
C-2	Q3		TR NPC Silicon 2SC536KNP(F) For high frequency amp	
C-2	Q4		TR NPC Silicon 2SC536KNP(F) For high frequency amp	
C-3	Q5		FET Dual N-channel U440 For UVH ~ UHF	
D-3	Q6		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
D-3	Q7		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
D-2	Q8		TR PNP Silicon 2SA1161 For high speed switching	
E-2	Q9		TR PNP Silicon 2SA1161 For high speed switching	
	Q10		TR NPN Silicon 2SC2499 For VHF ~ UHF, Low noise amp	
D-2	IC1		IC Linear CA3102E	
B-1	P15	E40-1077-05	Pin connector 10P	
C-1	P46	E40-0276-05	Pin connector 2P	
E-2	P47	E40-0476-05	Pin connector 4P	
C-1	P51	E40-0576-05	Pin connector 5P	
A-2	S1	S33-2501-05	Lever switch	
A-2	S2	S32-4008-05	Lever switch	
		J25-2909-23	Printed circuit board	

PARTS LIST

B TRIGGER SWITCH UNIT X77-1120-00

Fig. & Index No.	Ref. No.	Parts No.	Name & Description				Serial No. Eff.	
C-3	R1	RD14BB2B101J	RD	100Ω				
C-3	R2	RD14BB2B101J	RD	100Ω				
E-3	R3	RD14BB2B103J	RD	10kΩ				
B-2	R4	RD14BB2B473J	RD	47kΩ				
B-3	R5	RD14BB2B473J	RD	47kΩ				
B-2	R6	RD14BB2B103J	RD	10kΩ				
B-2	R7	RD14BB2B103J	RD	10kΩ				
C-2	R8	RD14BB2B471J	RD	470Ω				
C-3	R9	RD14BB2B220J	RD	22Ω				
C-2	R10	RD14BB2B101J	RD	100Ω				
C-3	R11	RD14BB2E105J	RD	1MΩ	±5%	1/4W		
C-2	R12	RD14BB2E105J	RD	1MΩ	±5%	1/4W		
C-3	R13	RN14BK2B3001F	RN	3kΩ	±1%	1/8W		
C-3	R14	RN14BK2B3001F	RN	3kΩ	±1%	1/8W		
C-2	R15	RD14BB2B220J	RD	22Ω				
C-2	R16	RD14BB2B220J	RD	22Ω				
C-2	R17	RD14BB2B562J	RD	5.6kΩ				
C-2	R18	RD14BB2B562J	RD	5.6kΩ				
C-2	R19	RN14BK2B2200F	RN	220Ω	±1%	1/8W		
C-2	R20	RN14BK2B2200F	RN	220Ω	±1%	1/8W		
D-2	R21	RN14BK2B1501F	RN	1.5kΩ	±1%	1/8W		
D-2	R22	RN14BK2B1501F	RN	1.5kΩ	±1%	1/8W		
D-2	R23	RN14BK2B7500F	RN	750Ω	±1%	1/8W		
D-2	R24	RN14BK2B2700F	RN	270Ω	±1%	1/8W		
D-2	R25	RN14BK2B2700F	RN	270Ω	±1%	1/8W		
D-2	R26	RD14BB2B220J	RD	22Ω				
D-2	R27	RD14BB2B220J	RD	22Ω				
E-2	R28	RD14BB2B100J	RD	10Ω				
E-2	R29	RD14BB2B680J	RD	68Ω				
E-2	R30	RD14BB2B680J	RD	68Ω				
	R31	No use						
	R32	No use						
D-2	R33	RD14BB2B220J	RD	22Ω				
D-2	R34	RD14BB2B220J	RD	22Ω				
D-2	R35	RD14BB2B473J	RD	47kΩ				
D-2	R36	RD14BB2B473J	RD	47kΩ				
D-2	R37	RD14BB2B220J	RD	22Ω				
D-2	R38	RD14BB2B220J	RD	22Ω				
D-2	R39	RD14BB2B271J	RD	270Ω				
D-2	R40	RD14BB2B271J	RD	270Ω				
D-3	R41	RD14BB2B220J	RD	22Ω				
D-3	R42	RD14BB2B470J	RD	47Ω				
C-3	R43	RD14BB2B101J	RD	100Ω				
C-3	R44	RD14BB2B222J	RD	2.2kΩ				
D-3	R45	RD14BB2B470J	RD	47Ω				
C-3	R46	RD14BB2B821J	RD	820Ω				
C-2	VR1	R01-2511-05	VR	5kΩB				
B-2	VR2	R12-3516-05	VR	10kΩB				
E-2	VR3	R12-0532-05	VR	100ΩB				
B-3	C1	C91-0502-05	Metalized film	0.01μF		630WV		
B-3	C2	CC45CH1H680J	CC	68pF	±5%			
B-3	C3	CC45CH1H680J	CC	68pF	±5%			
C-2	C4	CK45D1H103M	CK	0.01μF	±20%			
C-2	C5	CC45CH1H220J	CC	22pF	±5%			
C-2	C6	CC45CH1H220J	CC	22pF	±5%			
	C7	No use						
	C8	No use						
D-3	C9	CK45D1H103M	CK	0.01μF	±20%			
C-3	C10	CK45D1H103M	CK	0.01μF	±20%			
B-2	C11	C91-0549-05	Tantalum	1μF		35WV		
	C12	CE04W1C330M	CE	33μF		16WV		
E-3	C13	CE04W1C330M	CE	33μF		16WV		

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff
E-3	C14	CK45D1H103M	CK 0.01μF ±20%	
D-2	C15	CK45D1H103M	CK 0.01μF ±20%	
C-3	C16	CK45D1H103M	CK 0.01μF ±20%	
D-3	C17	CK45D1H103M	CK 0.01μF ±20%	
B-2	C18	C91-0549-05	Tantalum 1μF 35WV	
D-3	C19	CE04W1C330M	CE 33μF 16WV	
E-3	C20	CE04W1C330M	CE 33μF 16WV	
F-3	C21	CK45D1H103M	CK 0.01μF ±20%	
D-2	C22	CK45S1H103M	CK 0.01μF ±20%	
C-2	C23	CK45D1H103M	CK 0.01μF ±20%	
	C24	C90-0298-05	Semi-cnoductor ceramic 0.1μF 12WV	
E-2	TC1	C05-0412-05	TC 20pF	
E-3	L1	L40-2201-03	Ferri-inductor 22μH	
E-3	L2	L40-2201-03	Ferri-inductor 22μH	
C-3	D1		Diode Zener WZ-081 8.1V	
C-3	Q1		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
C-3	Q2		FET Dual N-channel U440 For VHF ~ UHF	
C-2	Q3		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
C-2	Q4		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
D-2	Q5		TR PNP Silicon 2SA1161 For high speed switching	
D-2	Q6		TR PNP Silicon 2SA1161 For high speed switching	
D-3	Q7		TR NPN Silicon 2SC2499 For VHF ~ UHF, low noise amp	
E-2	IC1		IC Linear CA3102E	
D-3	P43	E40-02 6-06	Pin connector 2P	
D-3	P44	E40-02 6-05	Pin connector 2P	
F-3	P45	E40-0676-05	Pin connector 6P	
C-4	P51	E40-0576-05	Pin connector 5P	
B-4	S1	S37-2005-05	Lever switch	
A-3	S2	S37-2005-05	Lever switch	
	S3	No use		
B-2	S4	S37-2005-05	Lever switch	
		J25-2919-02	Printed circuit board	
		J61-0506-05	Supporter (For P.C. board)	

PARTS LIST

POWER BLANKING UNIT X68-1310-00

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff.	
C-6	R1	RN14BK2B5102F	RN 51kΩ ±1% 1/8W		
C-6	R2	RN14BK2B5101F	RN 5.1kΩ ±1% 1/8W		
B-5	R3	RD14BB2B102J	RD 1kΩ		
B-5	R4	RD14BB2B562J	RD 5.6kΩ		
B-5	R5	RD14BB2B101J	RD 100Ω		
B-5	R6	RD14BB2B102J	RD 1kΩ		
C-5	R7	RN14BK2B1303F	RN 130kΩ ±1% 1/8W		
C-5	R8	RN14BK2B5601F	RN 5.6kΩ ±1% 1/8W		
C-4	R9	RD14BB2B561J	RD 560Ω		
C-4	R10	RD14BB2B392J	RD 3.9kΩ		
C-4	R11	RN14BK2B5101F	RN 5.1kΩ ±1% 1/8W		
C-4	R12	RN14BK2B5101F	RN 5.1kΩ ±1% 1/8W		
C-4	R13	RD14BB2B561J	RD 560Ω		
C-4	R14	RD14BB2B392J	RD 3.9kΩ		
C-4	R15	RN14BK2B1301F	RN 1.3kΩ ±1% 1/8W		
C-4	R16	RN14BK2B3901F	RN 3.9kΩ ±1% 1/8W		
C-5	R17	RD14BB2B561J	RD 560Ω		
C-5	R18	RD14BB2B222J	RD 2.2kΩ		
B-6	R19	RD14BB2E100J	RD 10Ω ±5% 1/4W		
B-6	R20	RN14BK2B1302F	RN 13kΩ ±1% 1/8W		
B-6	R21	RN14BK2B8201F	RN 8.2kΩ ±1% 1/8W		
D-5	R22	RD14BB2B472J	RD 4.7kΩ		
D-5	R23	RD14BB2B223J	RD 22kΩ		
D-5	R24	RD14BB2B103J	RD 10kΩ		
D-5	R25	RD14BB2B103J	RD 10kΩ		
D-6	R26	RD14BB2B682J	RD 6.8kΩ		
D-5	R27	RD14BB2B332J	RD 3.3kΩ		
D-6	R28	RD14BB2B332J	RD 3.3kΩ		
E-6	R29	RD14BB2B510J	RD 51Ω		
E-6	R30	RD14BB2B510J	RD 51Ω		
E-6	R31	RD14BB2B471J	RD 470Ω		
E-6	R32	RD14BB2B222J	RD 2.2kΩ		
E-5	R33	RD14BB2B222J	RD 2.2kΩ		
E-5	R34	RD14BB2B471J	RD 470Ω		
F-6	R35	RD14BB2B332J	RD 3.3kΩ		
F-6	R36	RD14BB2B102J	RD 1kΩ		
F-6	R37	RD14BB2B102J	RD 1kΩ		
E-5	R38	RD14BB2B332J	RD 3.3kΩ		
E-5	R39	RD14BB2B152J	RD 1.5kΩ		
E-5	R40	RD14BB2E101J	RD 100Ω ±5% 1/4W		
E-4	R41	RD14BB2B221J	RD 220Ω		
E-4	R42	RD14BB2B222J	RD 2.2kΩ		
D-4	R43	RD14BB2B103J	RD 10kΩ		
D-4	R44	RD14BB2B122J	RD 1.2kΩ		
E-4	R45	RD14BB2B753J	RD 75kΩ		
D-4	R46	RD14BB2B124J	RD 120kΩ		
D-4	R47	RD14BB2B562J	RD 5.6kΩ		
D-4	R48	RD14BB2B561J	RD 560Ω		
E-3	R49	RD14BB2B470J	RD 47Ω		
E-4	R50	RD14BB2B104J	RD 100kΩ		
E-5	R51	RD14BB2B221J	RD 220Ω		
E-5	R52	RD14BB2B103J	RD 10kΩ		
E-4	R53	RD14BB2B124J	RD 120kΩ		
E-4	R54	RD14BB2B124J	RD 120kΩ		
E-3	R55	RD14BB2B470J	RD 47Ω		
E-4	R56	RD14BB2B332J	RD 3.3kΩ		
E-3	R57	RD14BB2B561J	RD 560Ω		
C-3	R58	RD14BB2B683J	RD 68kΩ		
C-3	R59	RD14BB2B683J	RD 68kΩ		
C-3	R60	RD14BB2B102J	RD 1kΩ		
C-3	R61	RD14BB2B102J	RD 1kΩ		
C-3	R62	RD14BB2B103J	RD 10kΩ		
C-4	R63	RD14BB2B102J	RD 1kΩ		

PARTS LIST

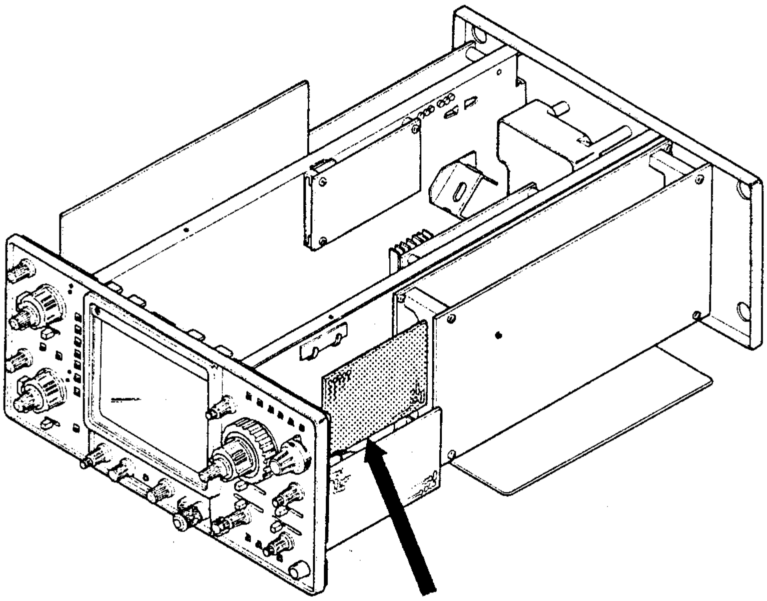
Fig. & Index No.	Ref. No.	Parts No.	Name & Description				Serial No. Eff.	
C-2	R64	RD14BB2B683J	RD	68kΩ				
B-2	R65	RD14BB2B103J	RD	10kΩ				
B-2	R66	RD14BB2B103J	RD	10kΩ				
C-2	R67	RD14BB2B102J	RD	1kΩ				
B-2	R68	RD14BB2B472J	RD	4.7kΩ				
B-1	R69	RD14BB2B330J	RD	33Ω				
D-2	R70	R92-0793-05	Metal glaze	15MΩ	±5%	1/2W		
F-2	R71	RC05GF2H335J	RC	3.3MΩ	±5%	1/2W		
F-2	R72	RC05GH2H226J	RC	22MΩ	±5%	1/2W		
E-2	R73	R92-0755-05	Metal glaze	3MΩ	±5%	1/2W		
E-2	R74	R92-0756-05	Metal glaze	47MΩ	±5%	1/2W		
A-4	R75	RD14BB2B562J	RD	5.6kΩ				
A-3	R76	RD14BB2B563J	RD	56kΩ				
A-3	R77	RD14BB2B473J	RD	47kΩ				
B-3	R78	RD14BB2E101J	RD	100Ω	±5%	1/4W		
B-3	R79	RD14BB2E221J	RD	220Ω	±5%	1/4W		
F-5	R80	RD14BB2B221J	RD	220Ω				
F-5	VR1	R03-3502-05	VR	10kΩ B				
C-3	VR2	R12-3041-05	VR	10kΩ B				
A-3	VR3	R12-3041-05	VR	10kΩ B				
G-3	VR4	R23-1501-05	VR	1kΩ B				
D-5	VR5	R12-3507-05	VR	15kΩ B				
E-6	VR6	R12-3507-05	VR	15kΩ B				
C-2	VR7	R12-3042-05	VR	47kΩ B				
G-2	VR8	R05-8001-05	VR	3MΩ B				
A-4	VR9	R12-5501-05	VR	150kΩ B				
C-6	C1	CK45D1H103M	CK	0.01μF	±20%			
B-5	C2	CE04W1V100M	CE	10μF		35WV		
C-6	C3	CE04W1J330M	CE	33μF		63WV		
B-5	C4	CE04W2C3R3M	CE	3.3μF		160WV		
C-5	C5	CE04W2C3R3M	CE	3.3μF		160WV		
C-4	C6	CE04W1C330M	CE	33μF		16WV		
C-4	C7	C91-0549-05	Tantalum	1μF		35WV		
C-4	C8	CE04W1E101M	CE	100μF		25WV		
C-4	C9	CE04W1E101M	CE	100μF		25WV		
C-5	C10	CE04W1A221M	CE	220μF		10WV		
B-6	C11	CE04W1V100M	CE	10μF		35WV		
B-6	C12	CK45D1H103M	CK	0.01μF	±20%			
C-5	C13	CE04W1V470M	CE	47μF		35WV		
B-3	C14	CK45D1H103M	CK	0.01μF	±20%			
B-3	C15	CK45D1H103M	CK	0.01μF	±20%			
B-3	C16	CK45D1H103M	CK	0.01μF	±20%			
E-6	C17	CC45CH1H680J	CC	68pF	±5%			
E-5	C18	CC45CH1H680J	CC	68pF	±5%			
E-5	C19	CK45D1H472M	CK	4700pF	±20%			
E-5	C20	CK45D1H472M	CK	4700pF	±20%			
F-5	C21	C91-0549-05	Tantalum	1μF		35WV		
F-5	C22	C91-0549-05	Tantalum	1μF		35WV		
E-4	C23	CC45CH1H180J	CC	18pF	±5%			
E-4	C24	CC45CH2H010C	CC	1pF	±0.25pF	500WV		
D-4	C25	CK45D2H472M	CK	4700pF	±20%	500WV		
D-4	C26	CK45D1H103M	CK	0.01μF	±20%			
E-4	C27	CC45CH2H010C	CC	1pF	±0.25pF	500WV		
E-4	C28	CK45D2H472M	CK	4700pF	±20%	500WV		
E-3	C29	CK45D1H103M	CK	0.01μF	±20%			
D-4	C30	CE04W2C3R3M	CE	3.3μF		160WV		
D-3	C31	CK45D2H472M	CK	4700pF	±20%	500WV		
D-5	C32	CE04W1A221M	CE	220μF		10WV		
D-5	C33	CK45D1H103M	CE	0.01μF	±20%			
D-4	C34	CE04W1E101M	CE	100μF		25WV		
D-4	C35	CK45D1H103M	CK	0.01μF	±20%			
D-3	C36	CK45E3D103P1	CK	0.01μF	+ 100%, − 0%	2000WV		

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description						Serial No. Eff
D-3	C37	CK45E3D103P	CK			0.01μF	+100%, −0%	2000WV	
E-3	C38	CK45E3D103PI	CK			0.01μF	+100%, −0%	2000WV	
E-3	C39	CK45E3D103PI	CK			0.01μF	+100%, −0%	2000WV	
D-2	C40	CK45D3D102M	CK			1000pF	±20%	2000WV	
C-2	C41	CQ93M1H154K	CQ			0.15μF	±10%		
C-2	C42	CK45D1H103M	CK			0.01μF	±20%		
C-2	C43	CK45D1H472M	CK			4700pF	±20%		
C-2	C44	CE04W1E470M	CE			47μF		25WV	
B-2	C45	CK45D1H103M	CK			0.01μF	±20%		
B-2	C46	CE04W1E470M	CE			47μF		25WV	
B-2	C47	CK45D1H103M	CK			0.01μF	±20%		
B-1	C48	CE04W1E470M	CE			47μF		25WV	
B-2	C49	CQ93M1H472K	CQ			4700pF	±10%		
C-3	C50	CE04W1E470M	CE			47μF		25WV	
C-3	C51	CK45D1H472M	CK			4700pF	±20%		
D-1	C52	CK45E3D103P	CK			0.01μF	+100%, −0%	2000WV	
F-2	C53	CK45E3D103P	CK			0.01μF	+100%, −0%	2000WV	
F-1	C54	CK45D3D102M	CK			1000pF	±20%	2000WV	
B-3	C55	CK45D2H222M	CK			2200pF	±20%	500WV	
B-3	C56	CK45D2H222M	CK			2200pF	±20%	500WV	
	C57	CC45CH1H680J	CC			68pF	±5%		
	C58	CC45CH1H680J	CC			68pF	±5%		
D-6	TC1	C05-0405-05	TC			20pF			
E-4	TC2	C05-0405-05	TC			20pF			
E-4	TC3	C05-0403-05	TC			6pF			
C-6	L1	L40-1011-04	Ferri-inductor			100μH			
C-4	L2	L40-1001-01	Ferri-inductor			10μH			
C-6	L3	L40-1011-04	Ferri-inductor			100μH			
D-5	L4	L40-1011-04	Ferri-inductor			100μH			
D-4	L5	L40-1011-04	Ferri-inductor			100μH			
D-4	L6	L40-1011-04	Ferri-inductor			100μH			
B-2	L7	L40-1011-03	Ferri-inductor			100μH			
B-2	L8	L40-1011-04	Ferri-inductor			100μH			
B-2	L9	L40-1011-04	Ferri-inductor			100μH			
B-5	D1		Diode		Silicon	DS442X	For switching		
B-4	D2		Diode		Zener	WZ-120	12V		
B-4	D3		Diode		Zener	WZ-120	12V		
E-5	D4		Diode		Zener	WZ-120	12V		
E-5	D5		Diode		Silicon	DS442X	For switching		
D-5	D6		Diode		Silicon	DS442X	For switching		
E-5	D7		Diode		Zener	WZ-090	9V		
D-3	D8		Diode		Silicon	1SS83	For switching		
E-3	D9		Diode		Silicon	1SS83	For switching		
D-2	D10		Diode		Silicon	W06C	For rectifier power		
D-2	D11		Diode		Silicon	W06C	For Rectifier power		
F-2	D12		Diode		Silicon	W06C	For rectifier power		
F-1	D13		Diode		Silicon	W06C	For rectifier power		
C-2	D14		Diode		Silicon	DS442X	For switching		
C-2	D15		Diode		Silicon	DS442X	For switching		
C-2	D16		Diode		Zener	WZ-032	3.2V		
B-2	D17		Diode		Silicon	DS442X	For switching		
	D18		Diode		Zener	WZ-061	6.1V		
B-5	Q1		TR	NPN	Silicon	2SC1913(Q or R)	For AF power		
B-5	Q2		TR	NPN	Silicon	2SC1505(L)	For video output, chroma modulator		
C-4	Q3		TR	PNP	Silicon	2SB633(E)	For AF power		
C-4	Q4		TR	NPN	Silicon	2SD613(E)	For AF power		
C-5	Q5		TR	PNP	Silicon	2SB633(E)	For AF power		
B-6	Q6		TR	NPN	Silicon	2SC1505(L)	For video output, chroma modulator		
B-6	Q7		TR	NPN	Silicon	2SC536KNP(F)	For high frequency amp		
B-4	Q8		TR	NPN	Silicon	2SC1505(L)	For video output chroma modulator		
B-3	Q9		TR	NPN	Silicon	2SC536KNP(F)	For high frequency amp		
B-3	Q10		TR	PNP	Silicon	2SA608KNP(F)	For universal		

PARTS LIST

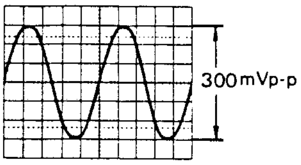
Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff
B-3	Q11		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
B-3	Q12		TR PNP Silicon 2SA608KNP(F) For universal	
E-5	Q13		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
E-5	Q14		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
E-5	Q15		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
D-5	Q16		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
D-5	Q17		TR NPN Silicon 2SC1047(C) For high frequency amp	
D-4	Q18		TR NPN Silicon 2SC1215(T or S) For high frequency amp	
E-3	Q19		TR NPN Silicon 2SC805A-2(2,3) For high speed switching	
D-4	Q20		TR PNP Silicon 2SA923-2(2,3) For high speed switching	
	Q21		TR NPN Silicon 2SC1811-2-2 For RF amplifier	
	Q22		TR PNP Silicon 2SA896-2-2 For RF amplifier	
C-3	Q23		TR NPN Silicon 2SC1811-2-2 For RF amplifier	
C-3	Q24		TR NPN Silicon 2SC1811-2-2 For RF amplifier	
B-2	Q25		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
C-2	Q26		TR NPN Silicon 2SC536KNP(F) For high frequency amp	
B-2	Q27		TR PNP Silicon 2SA608KNP(F) For universal	
C-2	Q28		FET N-channel 2SK19(BL) For VHF amplifier	
B-1	Q29		TR NPN Silicon 2SD613(E) For AM amplifier	
B-4	IC1		IC Linear NJM4558D	
B-5	IC2		IC Linear NJM4558D	
D-6	P22	E40-0776-05	Pin connector 7P	
F-5	P23a	E40-0476-05	Pin connector 4P	
F-3	P23b	E40-0476-05	Pin connector 4P	
B-3	P24	E40-0276-05	Pin connector 2P	
C-3	P25	E40-0276-05	Pin connector 2P	
F-6	P26a	E40-0576-05	Pin connector 5P	
F-3	P26b	E40-0576-05	Pin connector 5P	
D-5	P27	E40-0876-05	Pin connector 8P	
E-6	P28	E40-0476-05	Pin connector 4P	
A-2	P29	E40-0703-05	Pin connector 7P	
A-5	P30	E40-0746-05	Pin connector 7P	
	P31	No use		
A-3	P32	E40-0476-05	Pin connector 4P	
E-1	P33	E40-0332-05	Pin connector 3P	
E-6	P34	E40-0276-05	Pin connector 2P	
		E31-0762-05	Lead wire with connector	
		F01-0826-05	Heat sink	
		F02-0503-04	Heat sink	
		F20-0516-05	Sheet(Insulator)	
		F20-0623-05	Sheet(insulator)	
F-3	PL1	B30-0927-05	Pilot lamp	
F-3	PL2	B30-0927-05	Pilot lamp	
F-3	PL3	B30-0927-05	Pilot lamp	
F-3	PL4	B30-0927-05	Pilot lamp	
D-2	NL1		Neon lamp NE-2B	
D-2	NL2		Neon lamp NE-2B	
E-2	NL3		Neon lamp NE-2B	
E-2	NL4		Neon lamp NE-2B	
		J21-2930-04	Bracket	
		J30-0605-05	Spacer(For TR)	
		J25-2909-02	Printed circuit board	



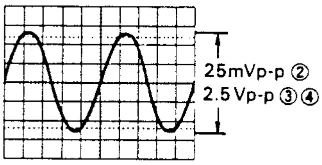
X74-1250-00
(SWEEP ROTARY UNIT)

WAVEFORMS

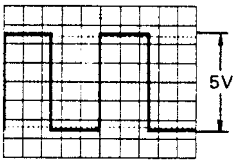
①



②③④

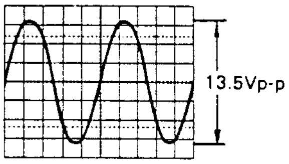


④ (at only ↕ TRACE SEP position)

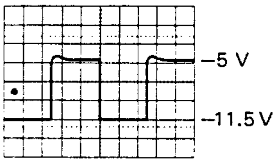


↕ TRACE. SEP MAX
(AC-GND-DC: GND)

⑤⑥



⑦ (at only ↕ TRACE SEP position)



↕ TRACE. SEP MAX

12-9

VOLTAGES AND WAVEFORMS

The voltages and waveforms are measured on each schematic diagram as follows;

TEST EQUIPEMENT

Digital multimeter	:	DL-720 (TRIO)
Oscilloscope	:	475A (TEKTRONIX)
Sine wave generator	:	SG-502 (TEKTRONIX)

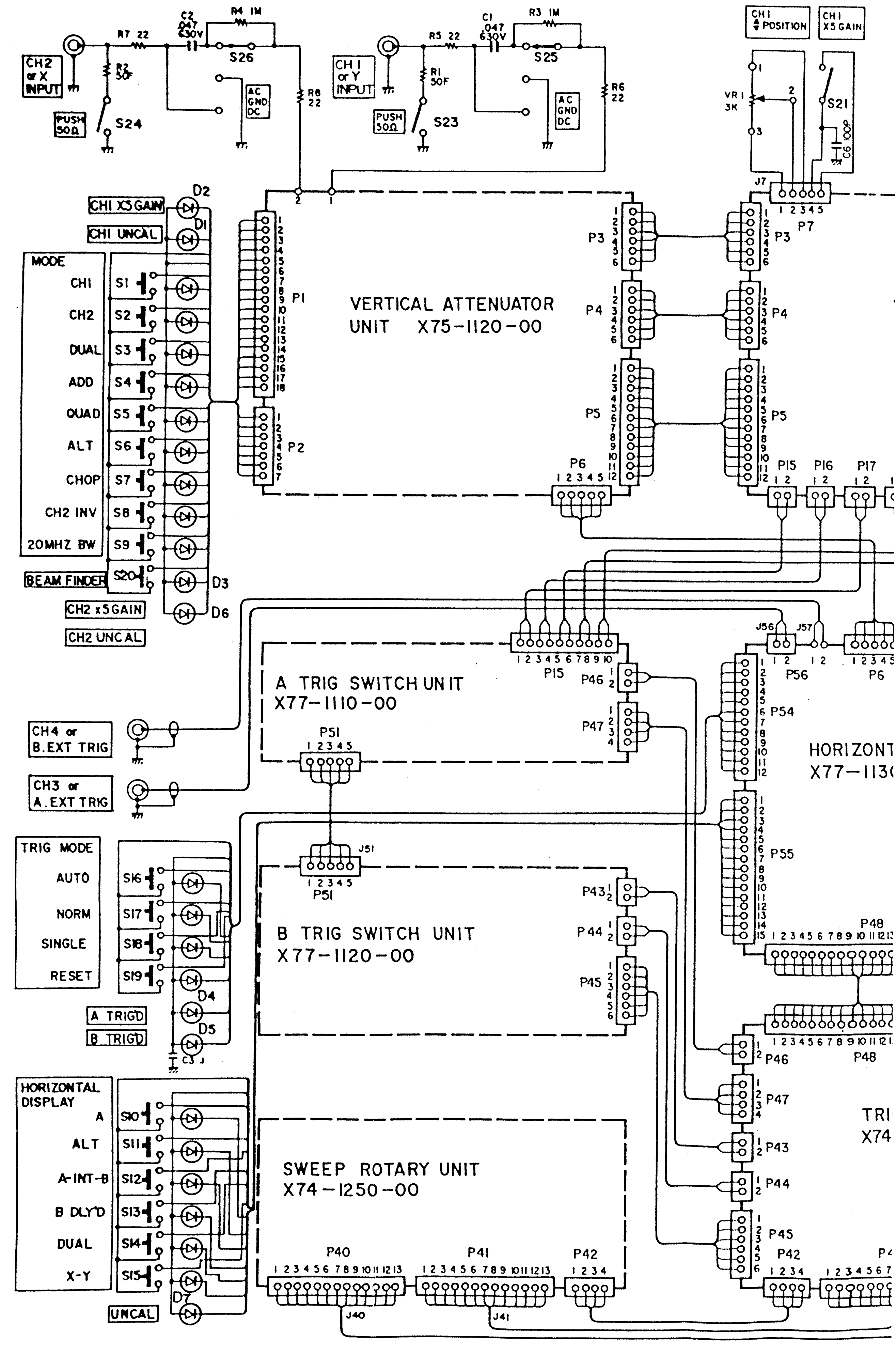
CONTROL SETTINGS

A INTENSITY	Midrange
FOCUS	Midrange
AC-GND-DC	GND for voltage measurement DC for waveform measurement
⬍ POSITION	Midrange
X GAIN	OFF
VOLTS/DIV	0.2V
V. VARIABLE	CAL
CH 2 INV	OFF
V. MODE	Unless otherwise specified CH 1
20 MHz BW	OFF
PUSH 50Ω	OFF
COUPLING	AC
SLOPE	+
TRIG. MODE	AUTO
HOLDOFF	NORM
A SWEEP TIME/DIV	0.2ms
B SWEEP TIME/DIV	50μs
A. VARIABLE	CAL
◂▸ POSITION	Midrange
H. DISPLAY	A
×10 MAG	OFF

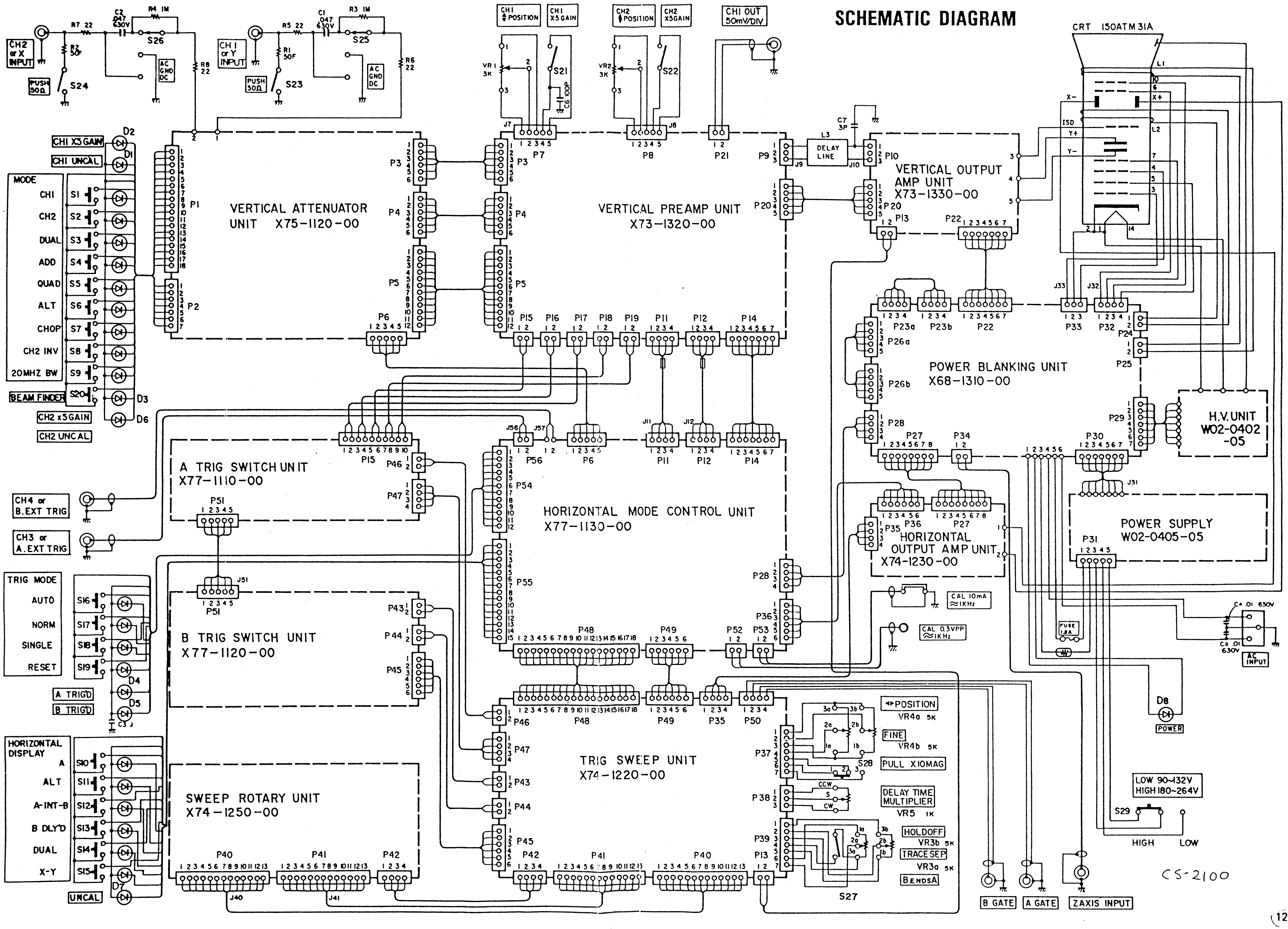
NOTE:
In differencial circuit, the voltages and waveforms are shown only CH 1 and CH 3.

Voltage Measurements
Voltage measurements are taken with no signal applied and the trace positioned to the center horizontal graticule line. The digital multimeter common should be connected to chassis ground at the nearest measurement point.

Waveform Condition
Waveforms are measured with 1 kHz 1Vp-p sine wave applied CH 1 input and 1 kHz 500m Vp-p applied CH3 input.


CH2 or X INPUT
CH1 or Y INPUT
PUSH 50Ω
S24
S23
S26
S25
AC GND DC
R7 22
R2 50F
C2 .047 630V
R4 1M
R8 22
R5 22
R1 50F
C1 .047 630V
R3 1M
R6 22
CH1 ⬍POSITION
CH1 X5 GAIN
VR1 3K
S21
C6
J7
P7
P3
P4
P5
P1
P2
P6
VERTICAL ATTENUATOR UNIT X75-1120-00
CH1 X5 GAIN
CH1 UNCAL
D1
D2
MODE
CH1
CH2
DUAL
ADD
QUAD
ALT
CHOP
CH2 INV
20MHZ BW
BEAM FINDER
S1
S2
S3
S4
S5
S6
S7
S8
S9
S20
D3
D6
CH2 x5GAIN
CH2 UNCAL
P15
P16
P17
J56
J57
P56
P6
P46
P47
P54
A TRIG SWITCH UNIT X77-1110-00
P51
CH4 or B.EXT TRIG
CH3 or A.EXT TRIG
HORIZONT
X77-113
P55
J51
TRIG MODE
AUTO
NORM
SINGLE
RESET
S16
S17
S18
S19
D4
D5
A TRIG'D
B TRIG'D
C3
B TRIG SWITCH UNIT X77-1120-00
P43
P44
P45
P48
HORIZONTAL DISPLAY
A
ALT
A-INT-B
B DLY'D
DUAL
X-Y
S10
S11
S12
S13
S14
S15
D7
UNCAL
SWEEP ROTARY UNIT X74-1250-00
P40
P41
P42
J40
J41
TRI
X74

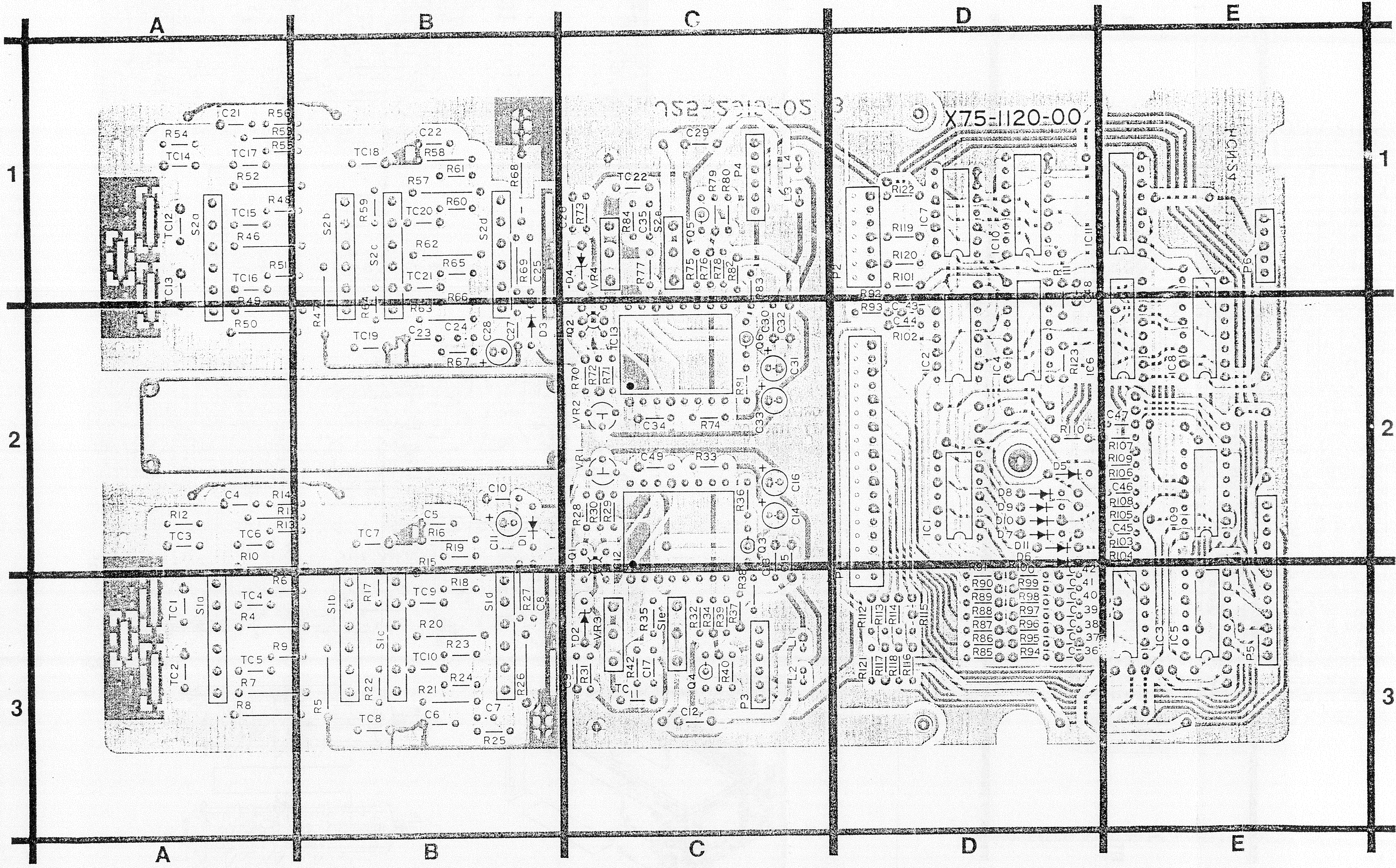
SCHEMATIC DIAGRAM

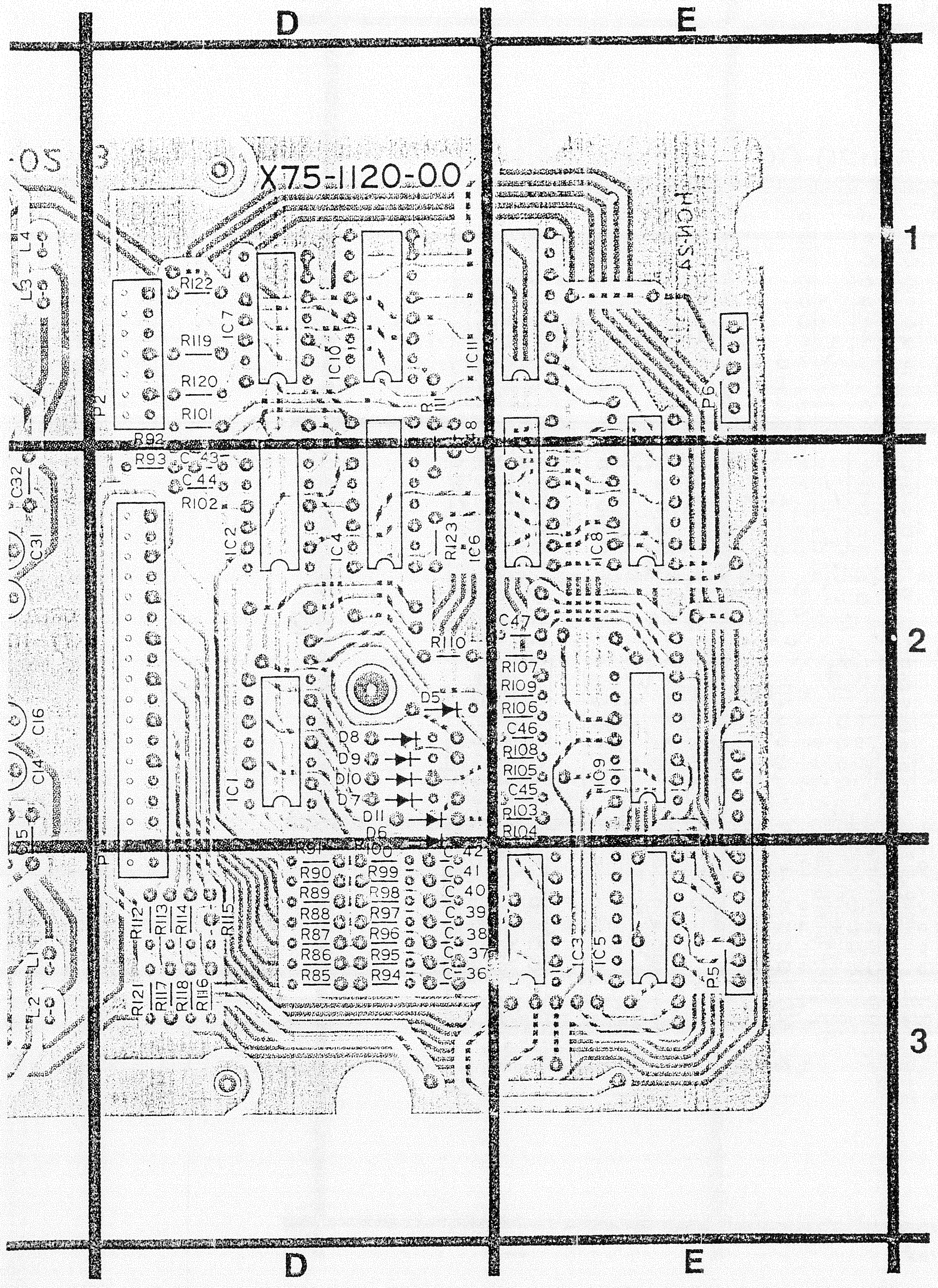

CRT 150ATM31A
CH2 or X INPUT
CH1 or Y INPUT
PUSH 50Ω
S24
S23
R7 22
R2 50F
C2 .047 630V
R4 1M
S26
AC GND DC
R8 22
R5 22
R1 50F
C1 .047 630V
R3 1M
S25
R6 22
CH1 ⇕POSITION
CH1 X5GAIN
CH2 ⇕POSITION
CH2 X5GAIN
CH1 OUT 50mV/DIV
VR1 3K
VR2 3K
S21
S22
C6 100P
C7 3P
L3 DELAY LINE
VERTICAL ATTENUATOR UNIT X75-1120-00
VERTICAL PREAMP UNIT X73-1320-00
VERTICAL OUTPUT AMP UNIT X73-1330-00
POWER BLANKING UNIT X68-1310-00
H.V. UNIT W02-0402-05
POWER SUPPLY W02-0405-05
A TRIG SWITCH UNIT X77-1110-00
B TRIG SWITCH UNIT X77-1120-00
HORIZONTAL MODE CONTROL UNIT X77-1130-00
HORIZONTAL OUTPUT AMP UNIT X74-1230-00
SWEEP ROTARY UNIT X74-1250-00
TRIG SWEEP UNIT X74-1220-00
CH1 X5GAIN
CH1 UNCAL
D1
D2
MODE
CH1 S1
CH2 S2
DUAL S3
ADD S4
QUAD S5
ALT S6
CHOP S7
CH2 INV S8
20MHZ BW S9
BEAM FINDER S20
D3
D6
CH2 x5GAIN
CH2 UNCAL
CH4 or B.EXT TRIG
CH3 or A.EXT TRIG
TRIG MODE
AUTO S16
NORM S17
SINGLE S18
RESET S19
D4
D5
A TRIG'D
B TRIG'D
C3
HORIZONTAL DISPLAY
A S10
ALT S11
A-INT-B S12
B DLY'D S13
DUAL S14
X-Y S15
D7
UNCAL
X-
X+
ISD
Y+
Y-
L1
L2
J7
J8
J9
J10
J11
J12
J31
J32
J33
J40
J41
J51
J56
J57
P1
P2
P3
P4
P5
P6
P7
P8
P9
P10
P11
P12
P13
P14
P15
P16
P17
P18
P19
P20
P21
P22
P23a
P23b
P24
P25
P26a
P26b
P27
P28
P29
P30
P31
P32
P33
P34
P35
P36
P37
P38
P39
P40
P41
P42
P43
P44
P45
P46
P47
P48
P49
P50
P51
P52
P53
P54
P55
P56
CAL 10mA ≈1KHz
CAL 0.3VPP ≈1KHz
FUSE 1.0A
C4 .01 630V
C5 .01 630V
AC INPUT
D8
POWER
LOW 90~132V
HIGH 180~264V
S29
HIGH
LOW
◂▸POSITION VR4a 5K
FINE VR4b 5K
PULL X10MAG
S28
DELAY TIME MULTIPLIER VR5 1K
CCW
CW
HOLDOFF VR3b 5K
TRACE SEP VR3a 5K
BENDS A
S27
B GATE
A GATE
Z AXIS INPUT

CS-2100

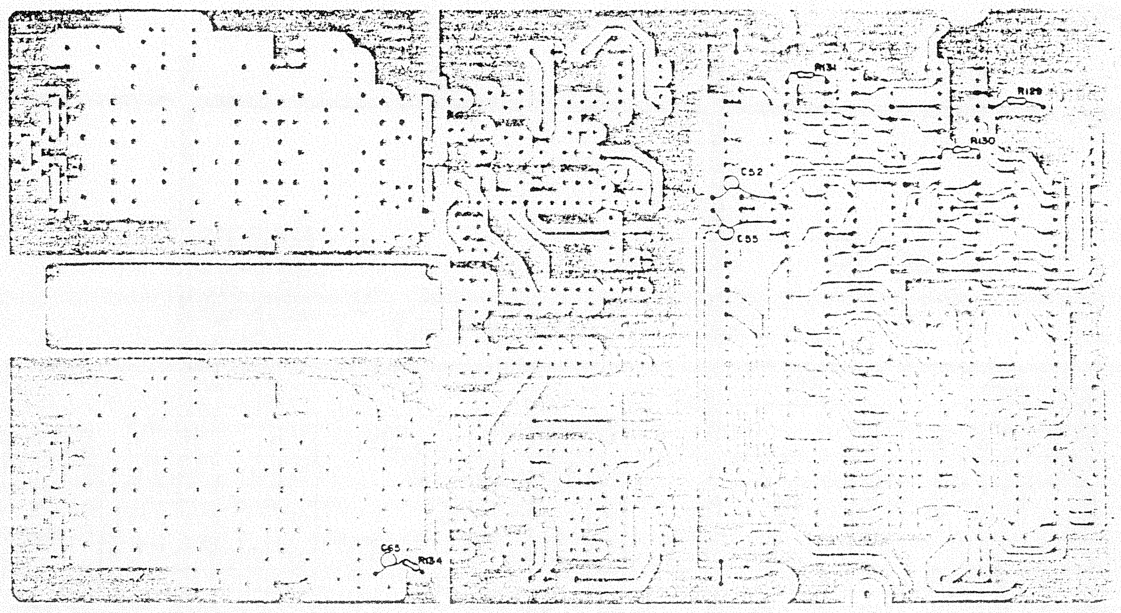
PC BOARD

X75-1120-00

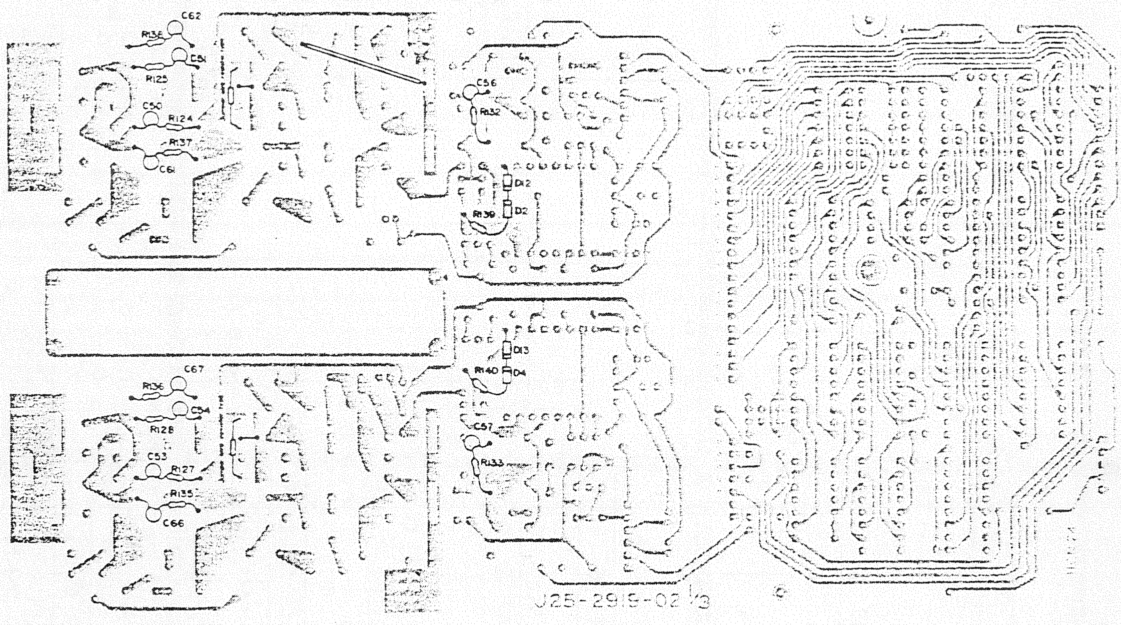

A
B
C
D
E
1
2
3
X75-1120-00
S2a
S2b
S2c
S2d
S2e
S1a
S1b
S1c
S1d
S1e
TC1
TC2
TC3
TC4
TC5
TC6
TC7
TC8
TC9
TC10
TC12
TC13
TC14
TC15
TC16
TC17
TC18
TC19
TC20
TC21
TC22
C4
C5
C6
C7
C8
C10
C11
C12
C14
C16
C17
C21
C22
C23
C24
C25
C27
C28
C29
C30
C31
C32
C33
C34
C35
C43
C44
C45
C46
C47
C49
R4
R5
R6
R7
R8
R9
R10
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
R25
R26
R27
R28
R29
R30
R31
R32
R33
R34
R35
R36
R37
R38
R39
R40
R42
R46
R48
R49
R50
R51
R52
R54
R55
R56
R57
R58
R59
R60
R61
R62
R63
R65
R66
R67
R68
R69
R70
R71
R72
R73
R74
R75
R76
R77
R78
R79
R80
R82
R83
R84
R85
R86
R87
R88
R89
R90
R91
R92
R93
R94
R95
R96
R97
R98
R99
R100
R101
R102
R103
R104
R105
R106
R107
R108
R109
R110
R111
R112
R113
R114
R115
R116
R117
R118
R119
R120
R121
R122
R123
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
Q1
Q2
Q3
Q4
Q5
Q6
VR1
VR2
VR3
VR4
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
IC12
IC13
L1
L2
L3
L4
L5
P1
P2
P3
P4
P5
P6


D
E
1
2
3
X75-1120-00
HCN-24
R122
R119
R120
R101
R92
R93
C43
C44
R102
IC7
IC10
IC11
IC2
IC4
IC6
IC8
IC9
IC1
IC3
IC5
R123
R110
C47
R107
R109
R106
C46
R108
R105
C45
R103
R104
D5
D8
D9
D10
D7
D11
D6
R100
R91
R90
R89
R88
R87
R86
R85
R99
R98
R97
R96
R95
R94
R112
R113
R114
R115
R121
R117
R118
R116
P2
P5
P6
P5
L1
L2
L3
L4
C31
C32
C16
C14
D
E

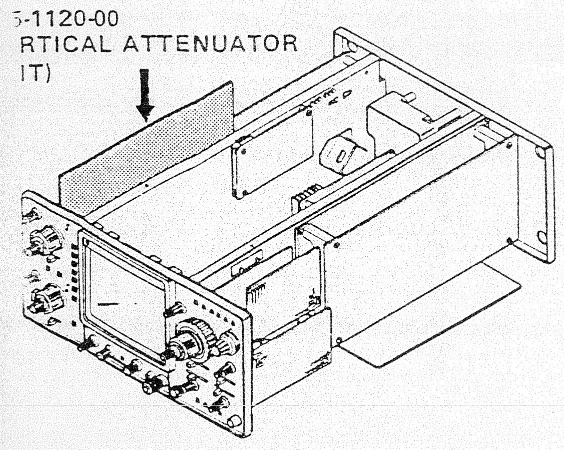
X75-1120-00

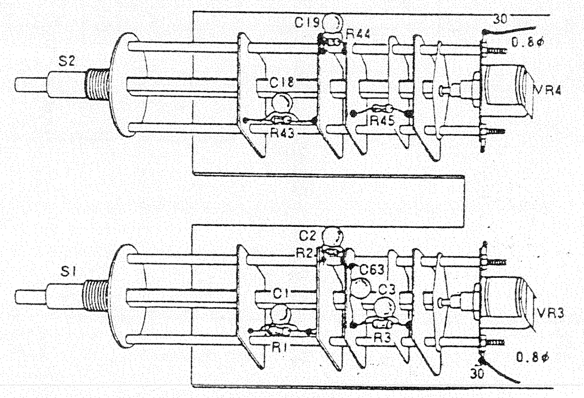

R131
R129
R130
C52
C55
C65
R134

(Parts Side View)


C62
R136
R125
C50
R124
R137
C61
C56
R132
D1
D2
R139
C67
R126
C54
C53
R127
R135
C66
D3
R140
D4
C57
R133
J25-2919-02

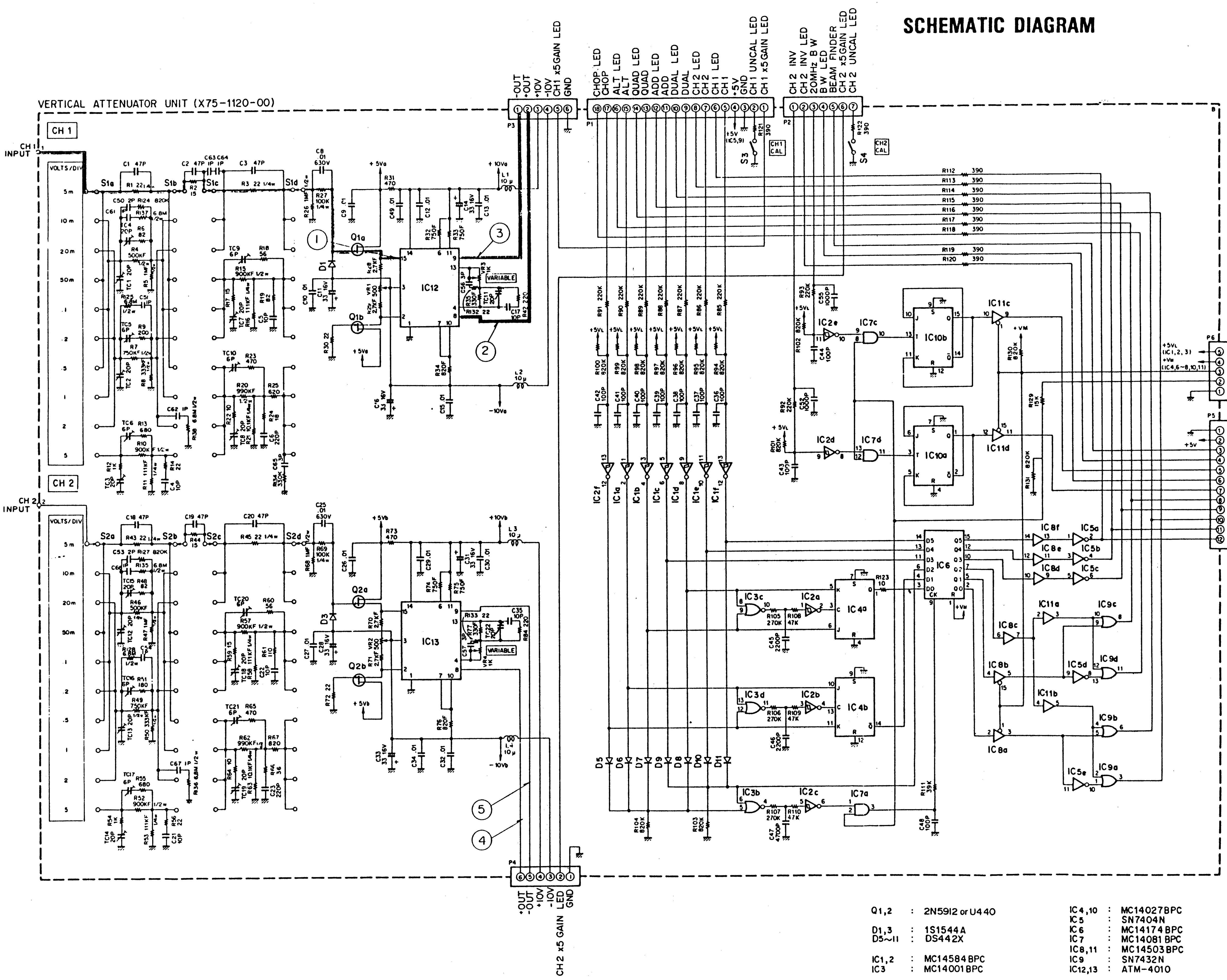
(Foil Side View)


-1120-00
RTICAL ATTENUATOR
IT)


S2
C19
R44
0.8φ
30
C18
VR4
R43
R45
S1
C2
R2
C63
C1
C3
VR3
R1
R3
0.8φ
30

Location of Parts in the Rotary Switch

SCHEMATIC DIAGRAM

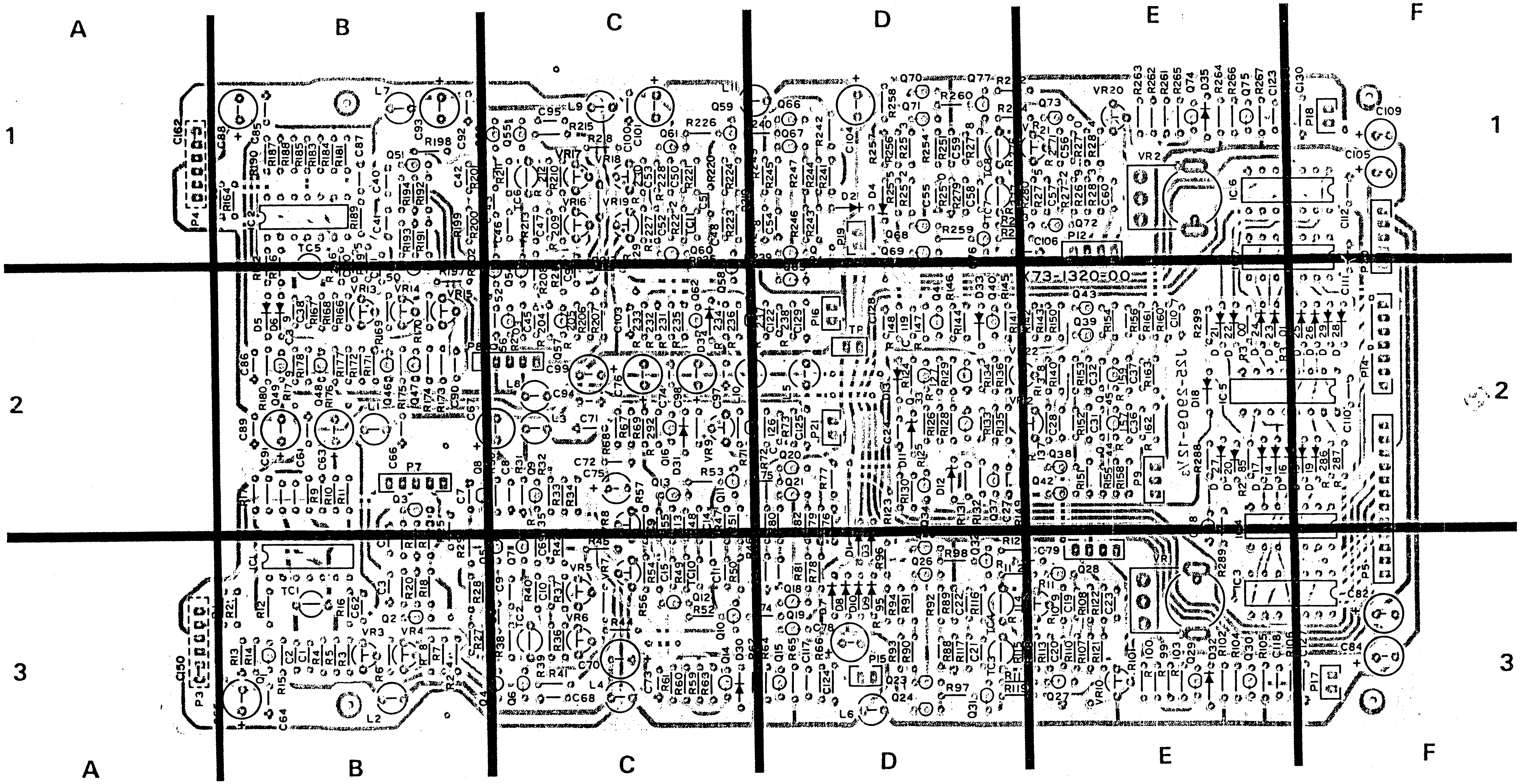

VERTICAL ATTENUATOR UNIT (X75-1120-00)
CH 1
CH 1 INPUT
CH 2
CH 2 INPUT
VOLTS/DIV
5m
10m
20m
50m
.1
.2
.5
1
2
5
S1a
S1b
S1c
S1d
S2a
S2b
S2c
S2d
Q1a
Q1b
Q2a
Q2b
D1
D3
IC12
IC13
VARIABLE
①
②
③
④
⑤
P1
P2
P3
P4
P5
P6
-OUT
+OUT
+10V
-10V
CH1 x5GAIN LED
GND
CHOP LED
CHOP
ALT LED
ALT
QUAD LED
QUAD
ADD LED
ADD
DUAL LED
DUAL
CH 2 LED
CH 2
CH 1 LED
CH 1
+5V
CH 1 UNCAL LED
CH 1 x5 GAIN LED
CH 2 INV
CH 2 INV LED
20MHz B W
B W LED
BEAM FINDER
CH 2 x5GAIN LED
CH 2 UNCAL LED
S3
CH1 CAL
S4
CH2 CAL
IC10a
IC10b
IC11a
IC11b
IC11c
IC11d
IC6
IC4a
IC4b
IC3b
IC3c
IC3d
IC2a
IC2b
IC2c
IC2d
IC2e
IC2f
IC1a
IC1b
IC1c
IC1d
IC1e
IC1f
IC7a
IC7c
IC7d
IC8a
IC8b
IC8c
IC8d
IC8e
IC8f
IC5a
IC5b
IC5c
IC5d
IC5e
IC9a
IC9b
IC9c
IC9d
D5
D6
D7
D8
D9
D10
D11
+5VL
+VM
CONT
CONT
GND
GND
+5V
BEAM FINDER
B W LED
20MHz B W
CH 2 INV LED
CH 2 INV
ALT
ADD
DUAL
CH 2
CH 1
+OUT
-OUT
+10V
-10V
CH 2 x5 GAIN LED
GND

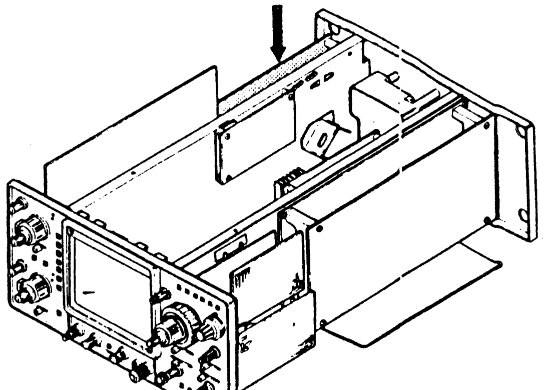
Q1,2 : 2N5912 or U440
D1,3 : 1S1544A
D5~11 : DS442X
IC1,2 : MC14584BPC
IC3 : MC14001BPC

IC4,10 : MC14027BPC
IC5 : SN7404N
IC6 : MC14174BPC
IC7 : MC14081BPC
IC8,11 : MC14503BPC
IC9 : SN7432N
IC12,13 : ATM-4010

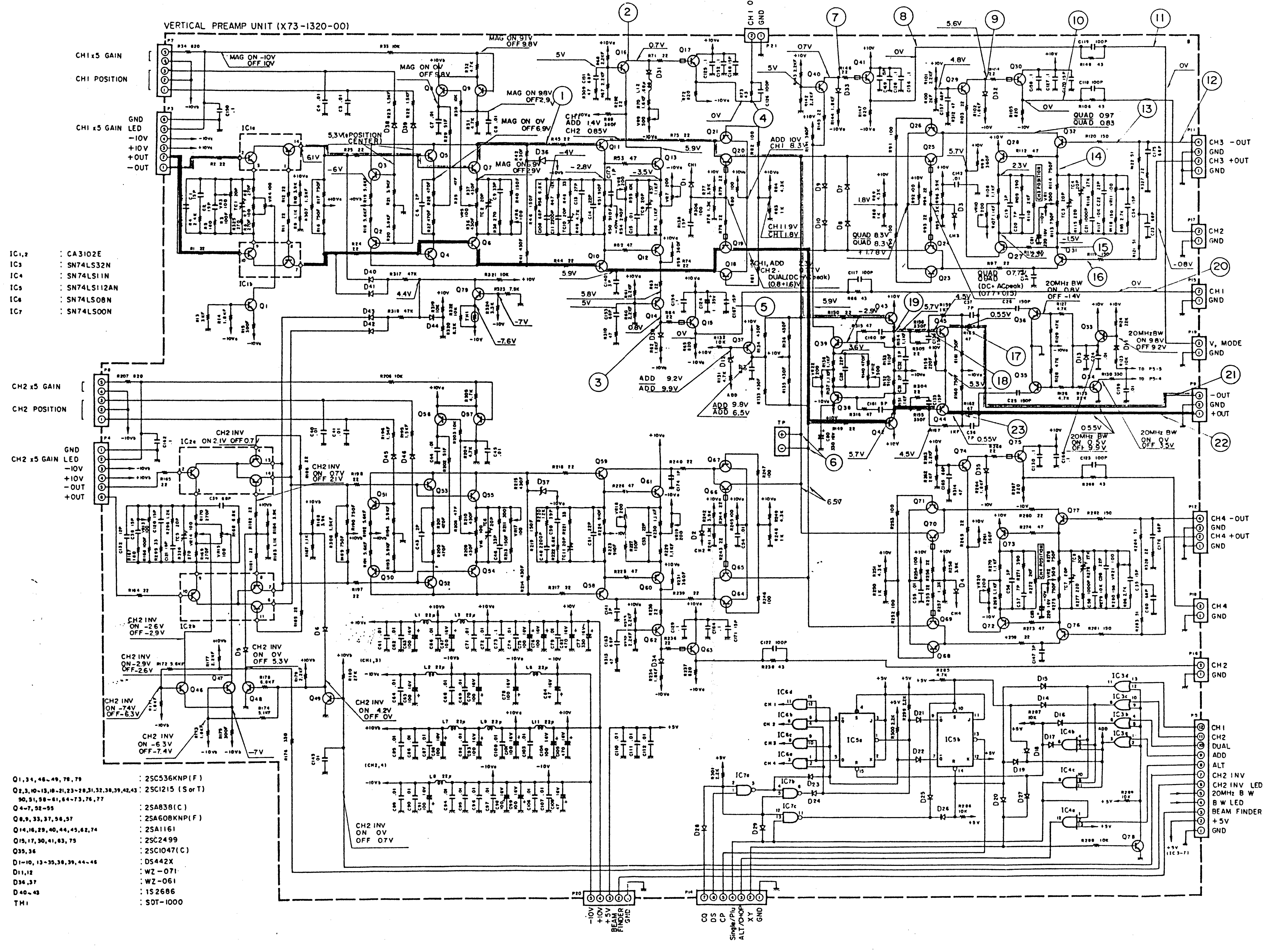
PC BOARD

X73-1320-00


A
B
C
D
E
F
1
2
3
X73-1320-00


X73-1320-00
(V. PRE AMP UNIT)

SCHEMATIC DIAGRAM

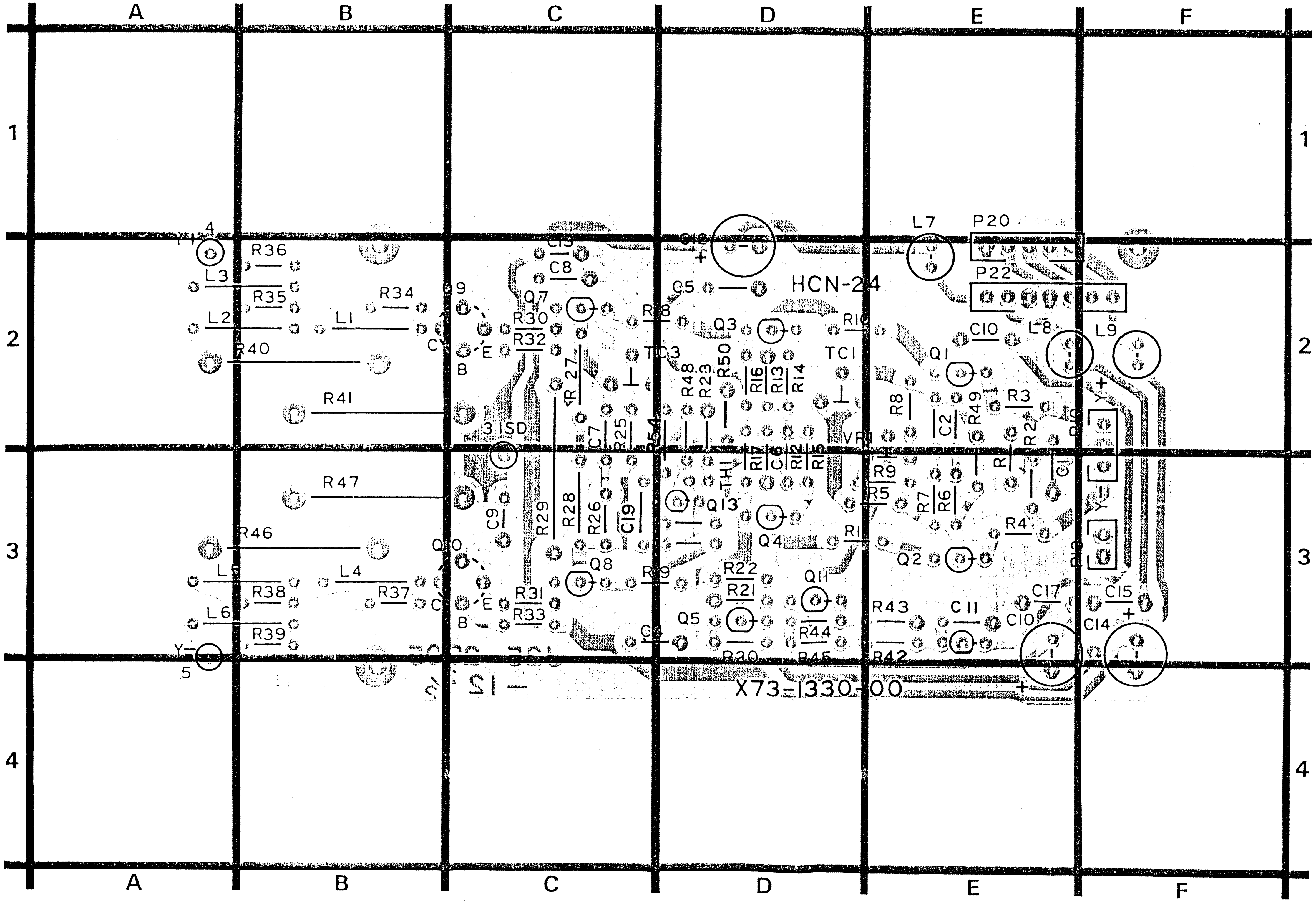

VERTICAL PREAMP UNIT (X73-1320-00)
CH1 x5 GAIN
CH1 POSITION
GND
CH1 x5 GAIN LED
-10V
+10V
+OUT
-OUT
CH2 x5 GAIN
CH2 POSITION
CH2 x5 GAIN LED
CH1 OUT
GND
CH3 -OUT
GND
CH3 +OUT
GND
CH2
GND
CH1
GND
V, MODE
GND
-OUT
GND
+OUT
CH4 -OUT
GND
CH4 +OUT
GND
CH4
GND
CH2
GND
CH1
CH2
DUAL
ADD
ALT
CH2 INV
CH2 INV LED
20MHz B W
B W LED
BEAM FINDER
+5V
GND
-10V
+10V
+5V
BEAM FINDER
GND
CQ
DS
CP
Single/Plu
ALT/CHOP
XY
GND
TP
MAG ON -10V
OFF 10V
MAG ON 9.1V
OFF 9.8V
MAG ON 0V
OFF 5.8V
MAG ON 9.8V
OFF 2.9V
MAG ON 0V
OFF 6.9V
5.3V (POSITION CENTER)
CH1 ADD 1.4V
CH2 0.85V
ADD 10V
CH1 8.3V
CH1 1.9V
CH1 1.8V
CH1, ADD
CH2
DUAL (DC+ACpeak)
(0.8+1.6V)
QUAD 8.3V
QUAD 8.3V
QUAD 0.97
QUAD 0.83
QUAD 0.77
QUAD 0.13
(DC+ ACpeak)
(0.77+0.13)
20MHz BW
ON 0.8V
OFF -1.4V
20MHz BW
ON 9.8V
OFF 9.2V
20MHz BW
ON 0.5V
OFF 9.8V
20MHz BW
ON 0V
OFF 3.5V
ADD 9.2V
ADD 9.9V
ADD 9.8V
ADD 6.5V
CH2 INV
ON 2.1V OFF 0.7
CH2 INV
ON 0.7V
OFF 2.1V
CH2 INV
ON -2.6V
OFF -2.9V
CH2 INV
ON -2.9V
OFF -2.6V
CH2 INV
ON 0V
OFF 5.3V
CH2 INV
ON -7.4V
OFF -6.3V
CH2 INV
ON -6.3V
OFF -7.4V
CH2 INV
ON 4.2V
OFF 0V
CH2 INV
ON 0V
OFF 0.7V
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23

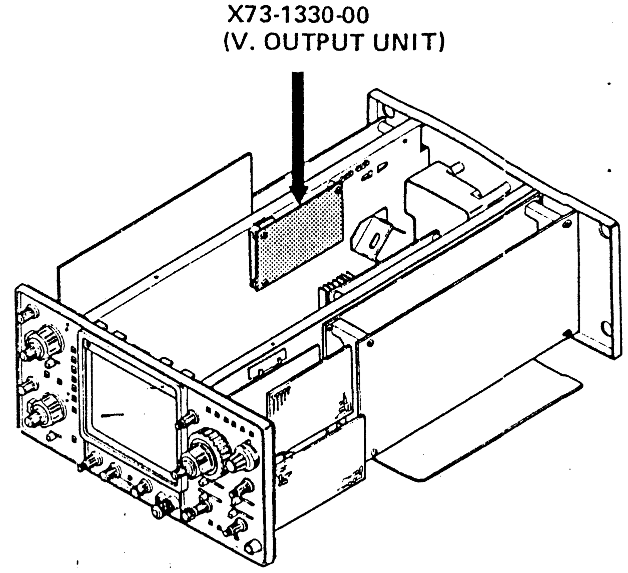
IC1,2 : CA3102E
IC3 : SN74LS32N
IC4 : SN74LS11N
IC5 : SN74LS112AN
IC6 : SN74LS08N
IC7 : SN74LS00N

Q1,34,46~49,78,79 : 2SC536KNP(F)
Q2,3,10~13,18~21,23~28,31,32,38,39,42,43 50,51,58~61,64~73,76,77 : 2SC1215 (S or T)
Q4~7,52~55 : 2SA838(C)
Q8,9,33,37,56,57 : 2SA608KNP(F)
Q14,16,29,40,44,45,62,74 : 2SA1161
Q15,17,30,41,63,75 : 2SC2499
Q35,36 : 2SC1047(C)
D1~10,13~35,38,39,44~46 : DS442X
D11,12 : WZ-071
D36,37 : WZ-061
D40~43 : 1S2686
TH1 : SDT-1000

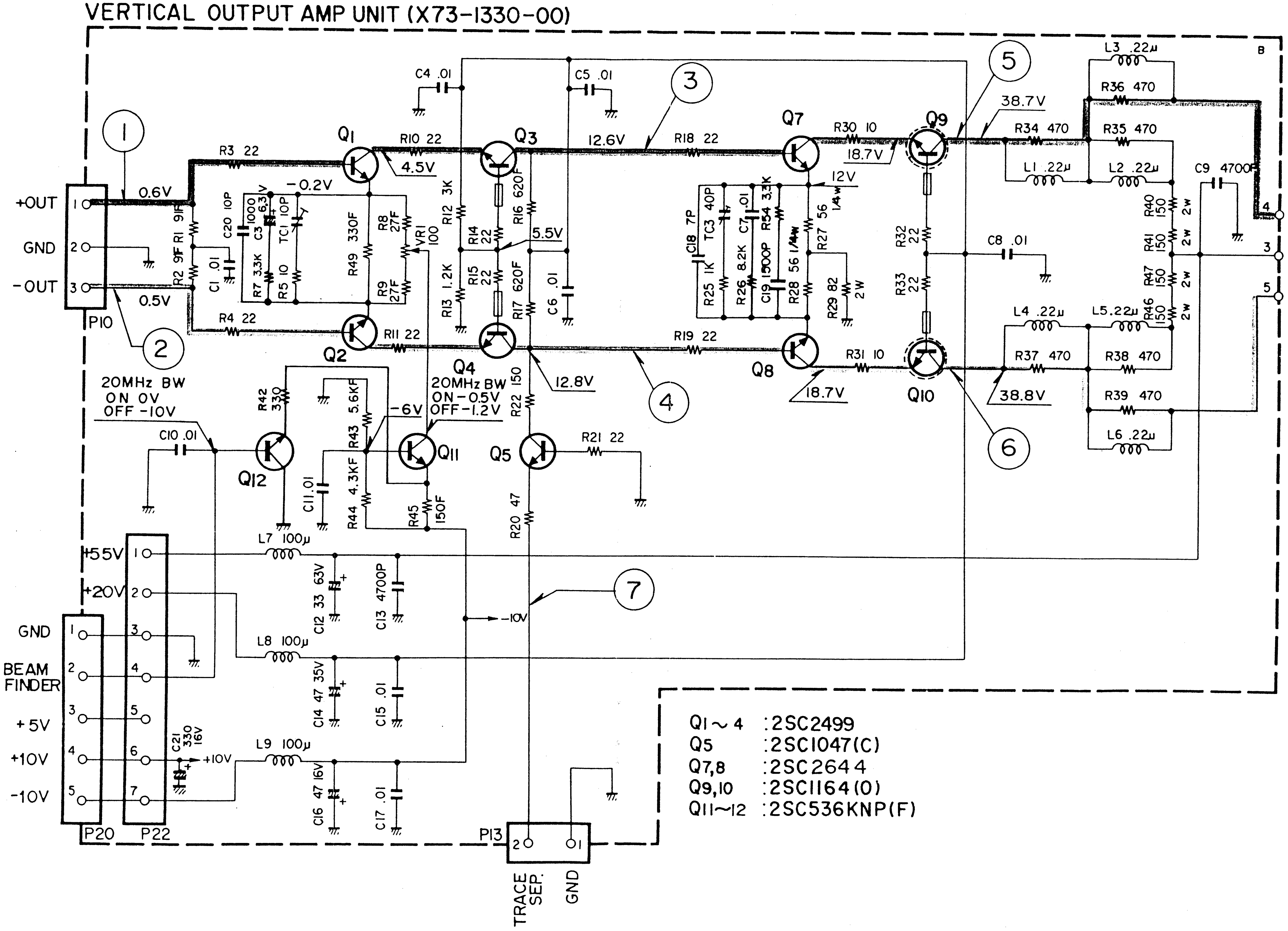
PC BOARD

X73-1330-00


A
B
C
D
E
F
1
2
3
4
Y+
4
Y−
5
R36
L3
R35
R34
L2
L1
R40
R41
R47
R46
L5
L4
R38
R37
L6
R39
Q9
C
E
B
Q10
C
E
B
C13
C8
Q7
R30
R32
R27
R31
R33
Q8
R29
R28
R26
C7
R25
C19
C9
3.1SD
R54
C12
C5
HCN-24
R18
R19
TC3
R48
R23
R50
Q3
R16
R13
R14
R17
C6
R12
R15
TH1
Q13
Q4
R22
R21
Q5
Q11
R44
R20
R45
C4
R10
TC1
VR1
R9
R5
R11
R8
L7
P20
P22
C10
L8
L9
Q1
C2
R49
R3
R24
R2
R7
R6
R4
Q2
R43
R42
C11
C10
C17
C15
C14
X73-1330-00
+


X73-1330-00
(V. OUTPUT UNIT)

SCHEMATIC DIAGRAM

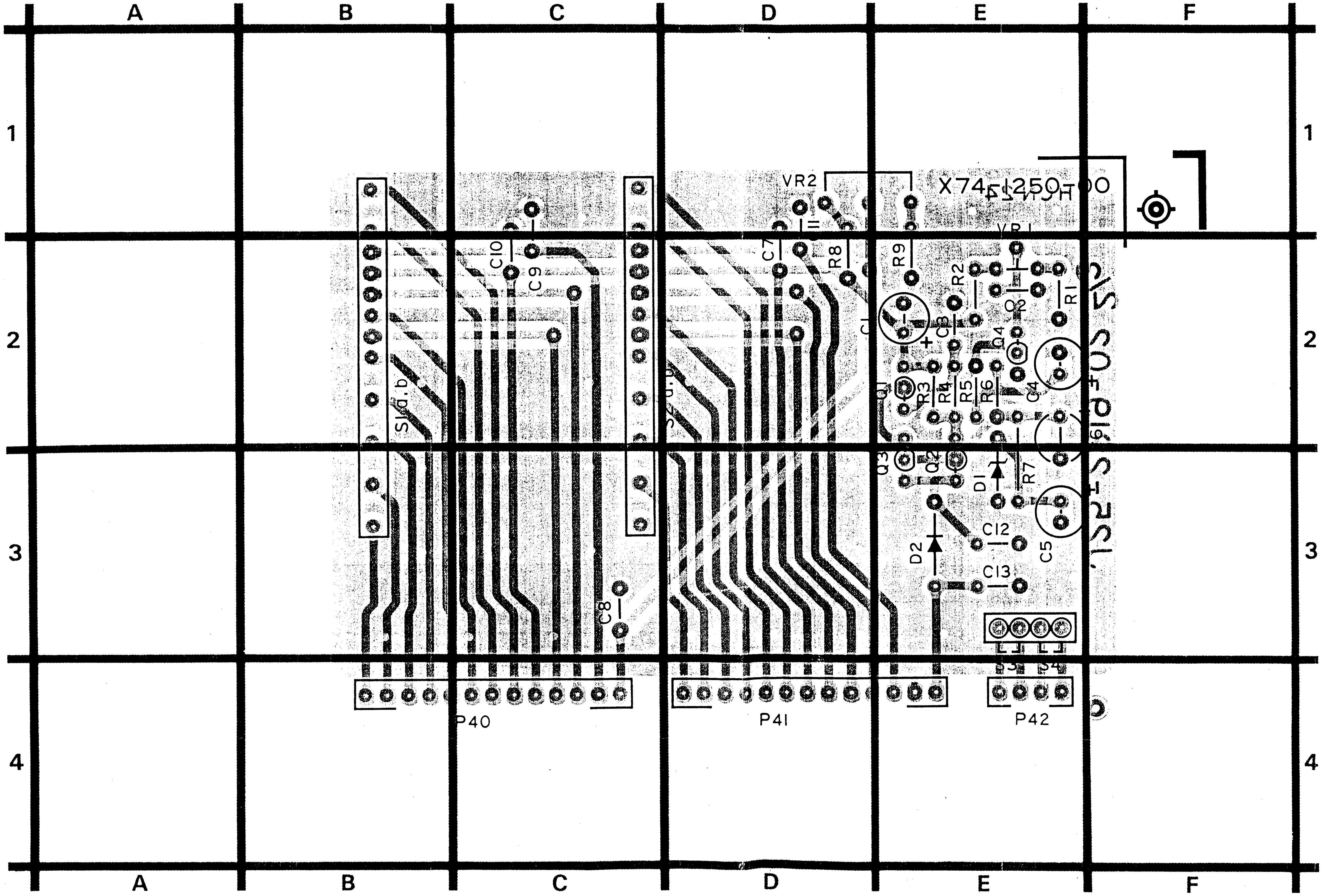

VERTICAL OUTPUT AMP UNIT (X73-1330-00)
+OUT
GND
-OUT
P10
0.6V
0.5V
R3 22
R4 22
R1 91F
R2 91F
C1 .01
C20 10P
C3 1000 6.3V
TC1 10P
R7 3.3K
R5 10
-0.2V
R49 330F
R8 27F
R9 27F
VR1 100
Q1
Q2
4.5V
R10 22
R11 22
Q3
Q4
C4 .01
C5 .01
R12 3K
R13 1.2K
R14 22
R15 22
R16 620F
R17 620F
5.5V
C6 .01
12.6V
12.8V
R18 22
R19 22
C18 7P
TC3 40P
C7 .01
R54 3.3K
R25 1K
R26 8.2K
C19 1500P
R28 56 1/4W
R27 56 1/4W
R29 82 2W
12V
Q7
Q8
R30 10
R31 10
18.7V
18.7V
Q9
Q10
R32 22
R33 22
C8 .01
38.7V
38.8V
L3 .22µ
R36 470
R34 470
R35 470
L1 .22µ
L2 .22µ
C9 4700P
R40 150 2W
R41 150 2W
R47 150 2W
R46 150 2W
L4 .22µ
L5 .22µ
R37 470
R38 470
R39 470
L6 .22µ
CRT(Y+)
CRT(ISD)
CRT(Y-)
20MHz BW
ON 0V
OFF -10V
C10 .01
Q12
R42 330
R43 5.6KF
C11 .01
R44 4.3KF
R45 150F
-6V
20MHz BW
ON -0.5V
OFF -1.2V
Q11
Q5
R22 150
R21 22
R20 47
+55V
+20V
L7 100µ
C12 33 63V
C13 4700P
L8 100µ
C14 47 35V
C15 .01
L9 100µ
C16 47 16V
C17 .01
C21 330 16V
+10V
-10V
GND
BEAM FINDER
+5V
+10V
-10V
P20
P22
P13
TRACE SEP.
GND
①
②
③
④
⑤
⑥
⑦

Q1～4 :2SC2499
Q5 :2SC1047(C)
Q7,8 :2SC2644
Q9,10 :2SC1164(O)
Q11～12 :2SC536KNP(F)

PC BOARD

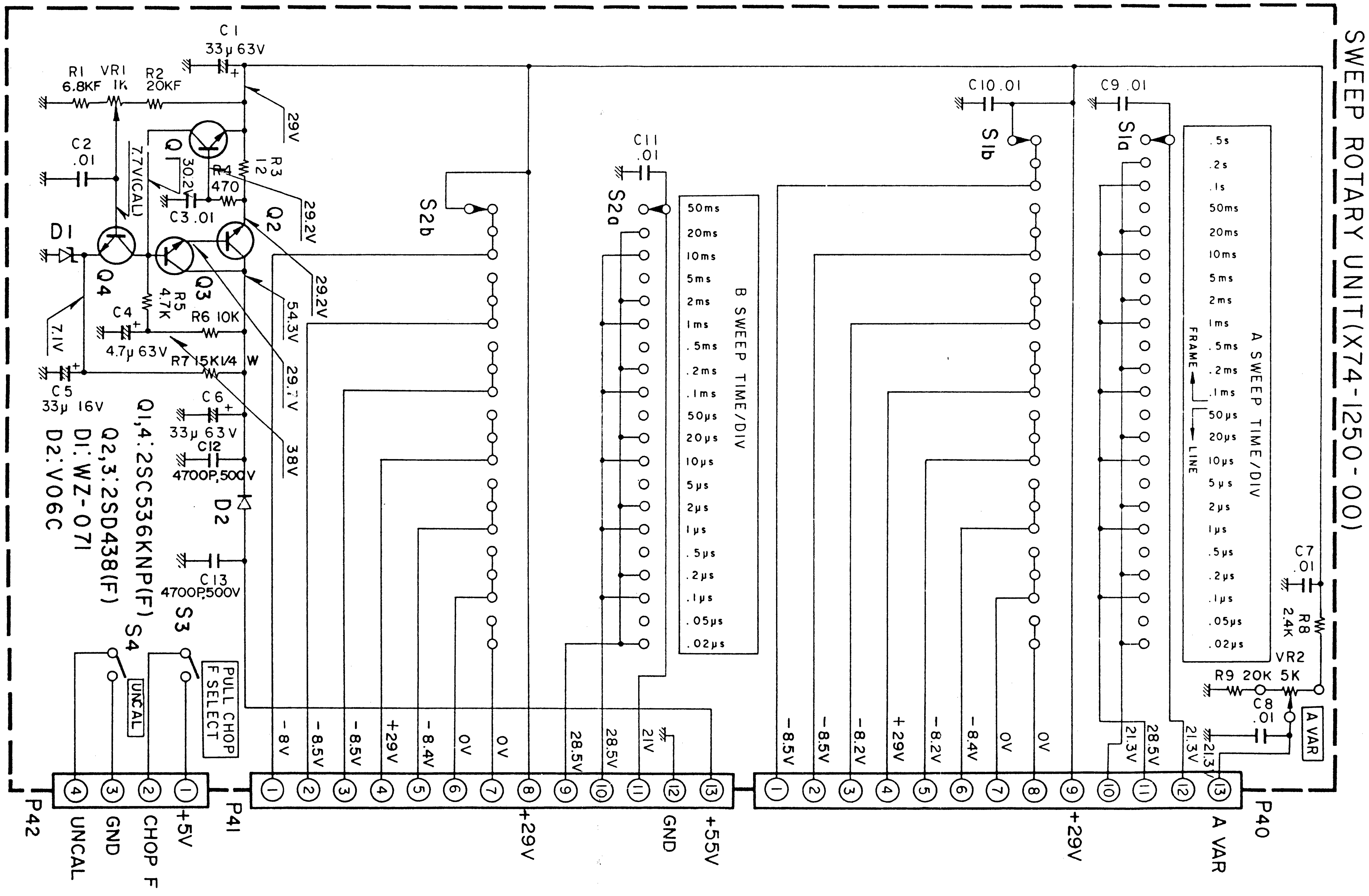
CS-2100

X74-1250-00


A
B
C
D
E
F
1
2
3
4
VR2
X74-1250-00
VR1
C10
C9
C7
R8
R9
R2
R1
C1
C3
Q4
Q1
R3
R4
R5
R6
C4
Q3
Q2
D1
R7
C12
C5
D2
C13
C8
S1a.b
S2a.b
P40
P41
P42

SCHEMATIC DIAGRAM

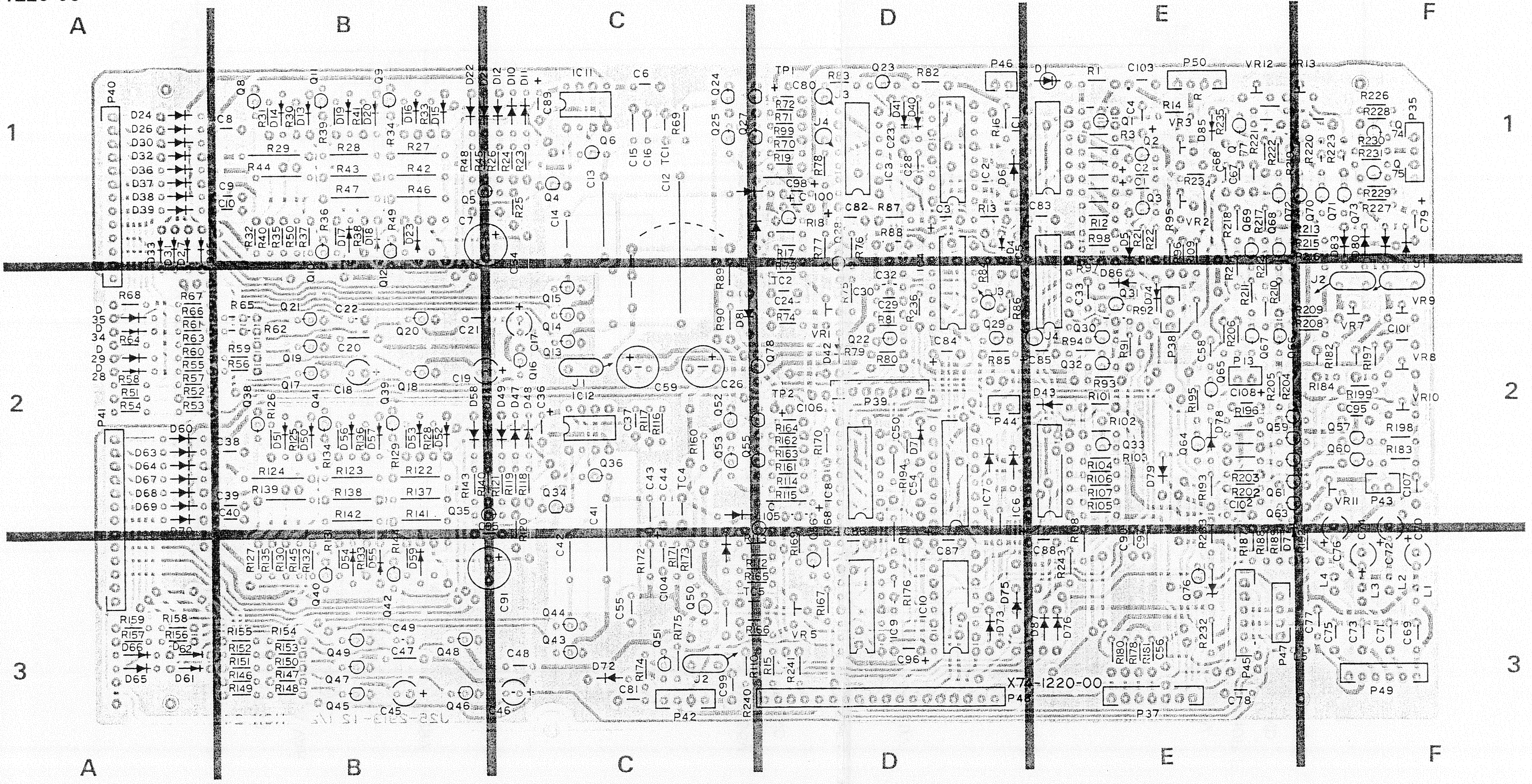
C S-2100


SWEEP ROTARY UNIT(X74-1250-00)
C1 33μ 63V
R1 6.8KF
VR1 1K
R2 20KF
29V
Q1
R3 12
R4 470
30.2V
7.7V(CAL)
C2 .01
C3 .01
Q2
29.2V
D1
Q4
Q3
R5 4.7K
R6 10K
C4 4.7μ 63V
54.3V
29.2V
7.1V
R7 15K1/4 W
29.1V
C5 33μ 16V
C6 33μ 63V
38V
C12 4700P,500V
D2
C13 4700P,500V
Q1,4: 2SC536KNP(F)
Q2,3: 2SD438(F)
D1: WZ-071
D2: V06C
S3
S4
UNCAL
PULL CHOP F SELECT
S2b
S2a
C11 .01
B SWEEP TIME/DIV
50ms
20ms
10ms
5ms
2ms
1ms
.5ms
.2ms
.1ms
50μs
20μs
10μs
5μs
2μs
1μs
.5μs
.2μs
.1μs
.05μs
.02μs
C10 .01
C9 .01
S1b
S1a
A SWEEP TIME/DIV
.5s
.2s
.1s
50ms
20ms
10ms
5ms
2ms
1ms
.5ms
.2ms
.1ms
50μs
20μs
10μs
5μs
2μs
1μs
.5μs
.2μs
.1μs
.05μs
.02μs
FRAME
LINE
C7 .01
R8 2.4K
VR2
R9 20K 5K
C8 .01
A VAR
-8V
-8.5V
-8.5V
+29V
-8.4V
0V
0V
28.5V
28.5V
21V
-8.5V
-8.5V
-8.2V
+29V
-8.2V
-8.4V
0V
0V
21.3V
28.5V
21.3V
21.3V
P42
UNCAL
GND
CHOP F
+5V
P41
+29V
GND
+55V
P40
+29V
A VAR

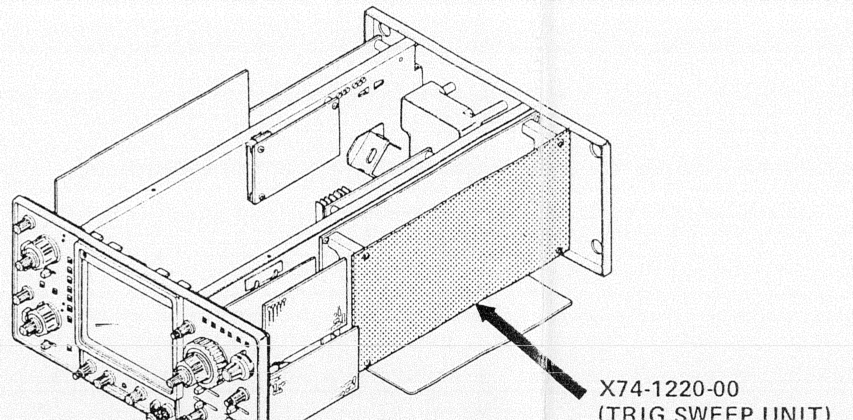
PC BOARD

CS-2100

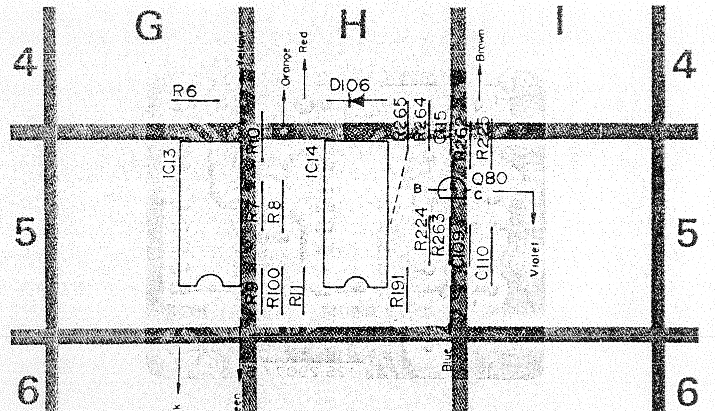
X74-1220-00



A
B
C
D
E
F
1
2
3
X74-1220-00
P40
P41
P35
P39
P42
P43
P44
P45
P46
P47
P48
P49
P50
P37
IC11
IC12
TP1
TP2
VR1
VR2
VR3
VR5
VR7
VR8
VR9
VR10
VR11
VR12
C59
C91
J2

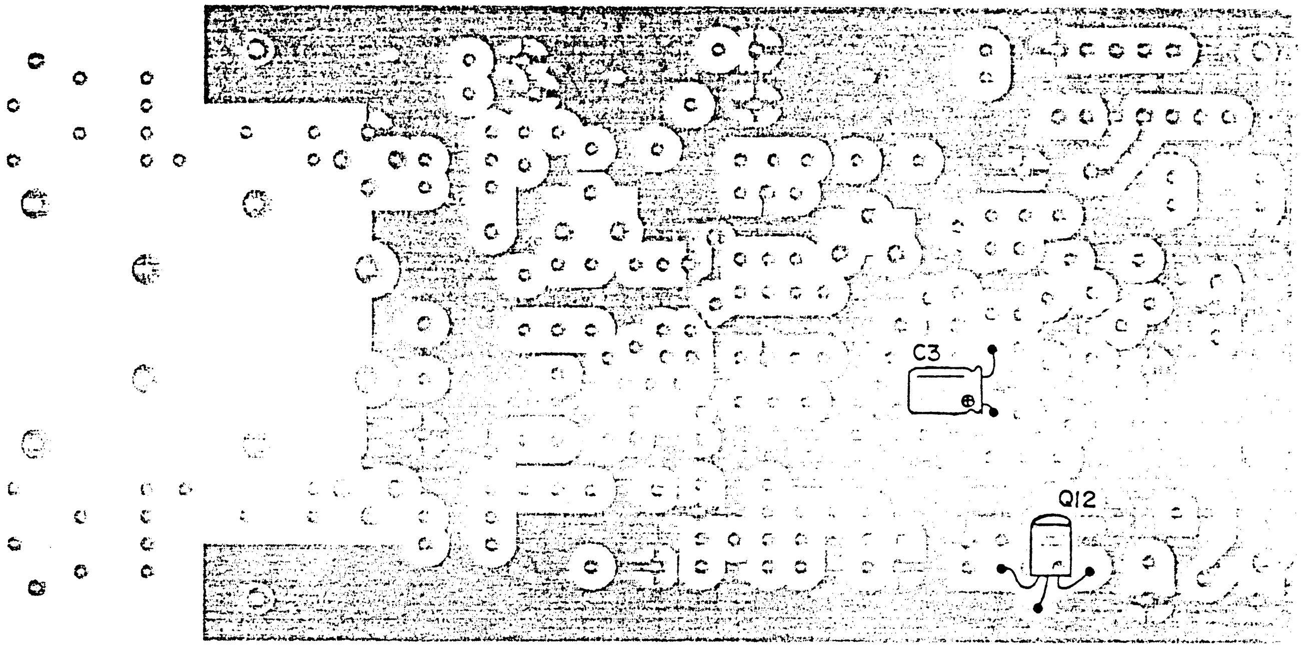


X74-1220-00
(TRIG SWEEP UNIT)

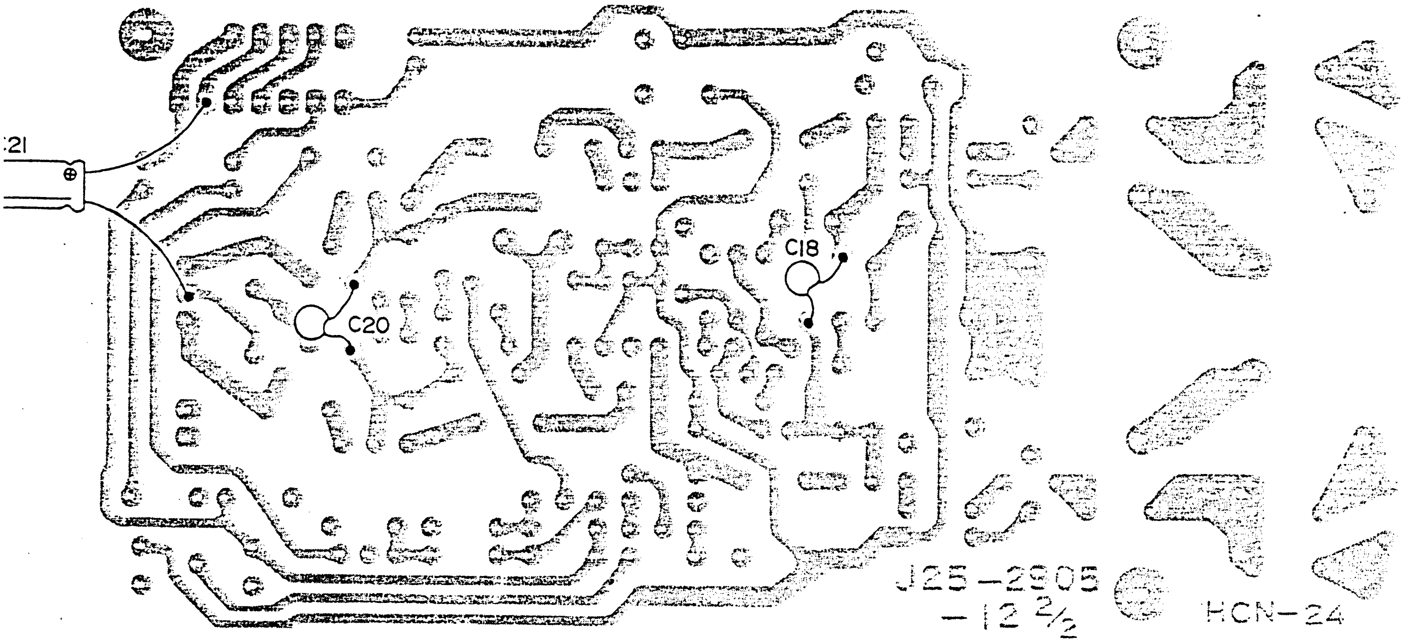


G
H
I
4
5
6
R6
D106
IC13
IC14
R8
R100
R11
R191
R224
R263
R264
R265
Q80
C110
Orange
Red
Brown
Violet

X73-1330-00



(Parts Side View)

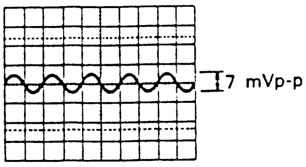

21
C18
C20
J25-2905
-12 2/2
HCN-24

(Foil Side View)

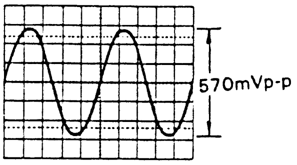
0

WAVEFORMS

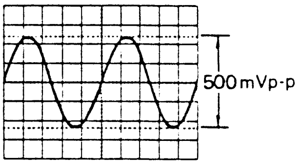
①



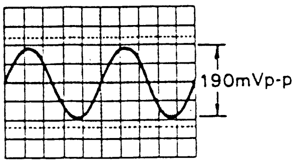
② ④



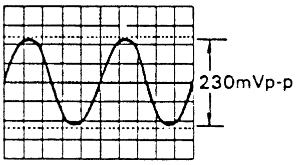
③ ⑤ ⑨ ⑩



⑥



⑦ ⑧



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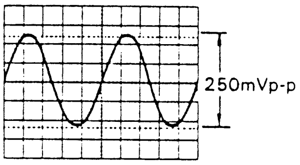
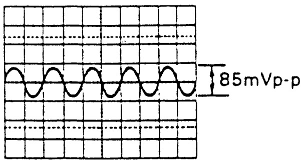
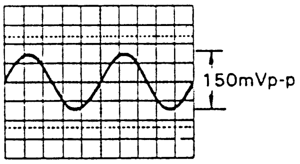


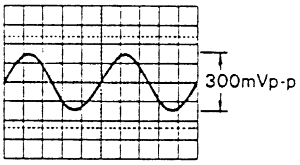
⑫



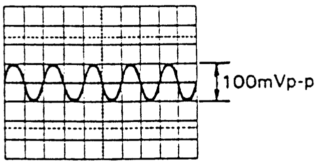
⑬ ⑭



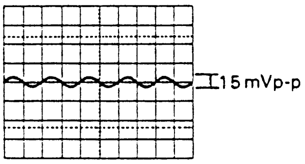
⑮ ⑯



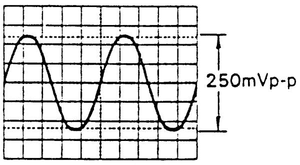
⑰



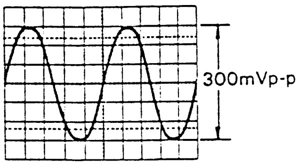
⑱



⑲ ⑳ ㉑



㉒



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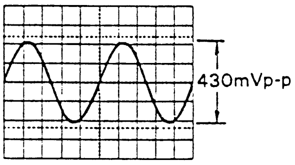
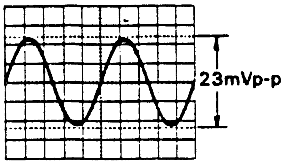


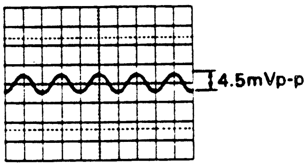
12-5

WAVEFORMS

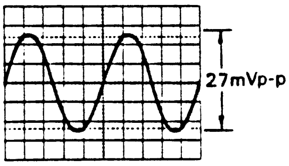
①



② ④

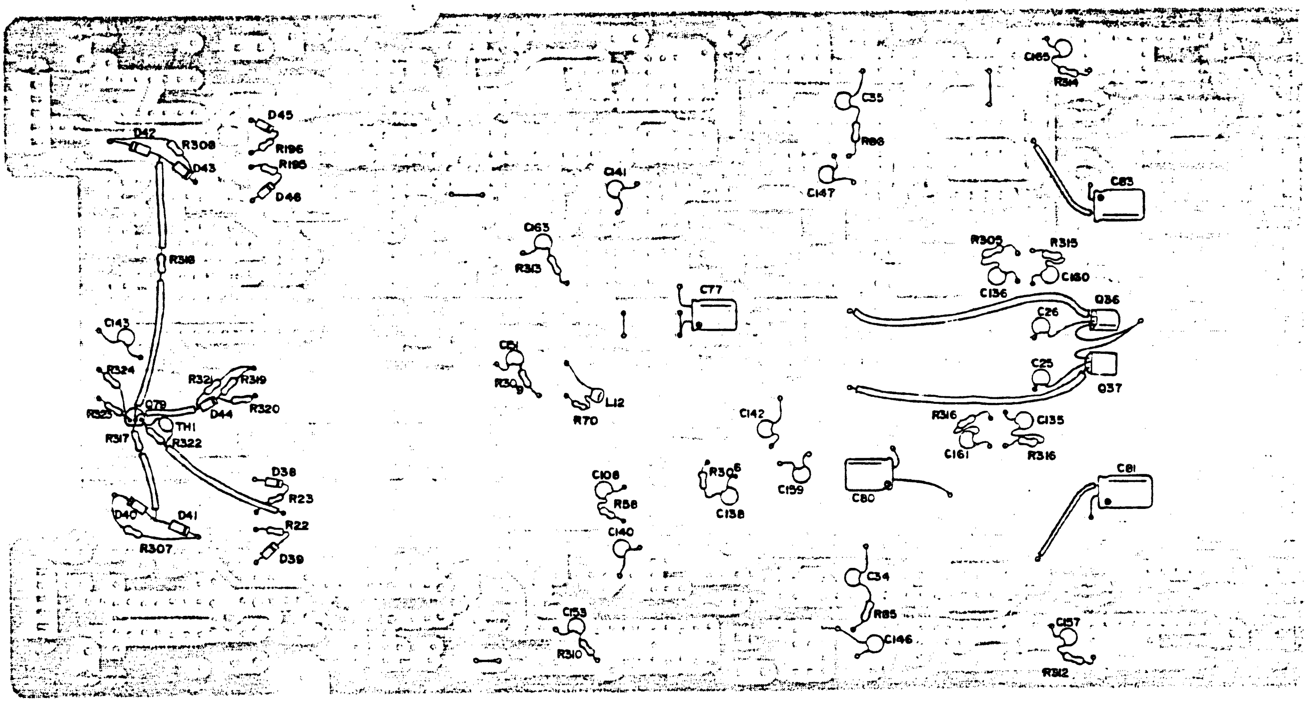


③ ⑤

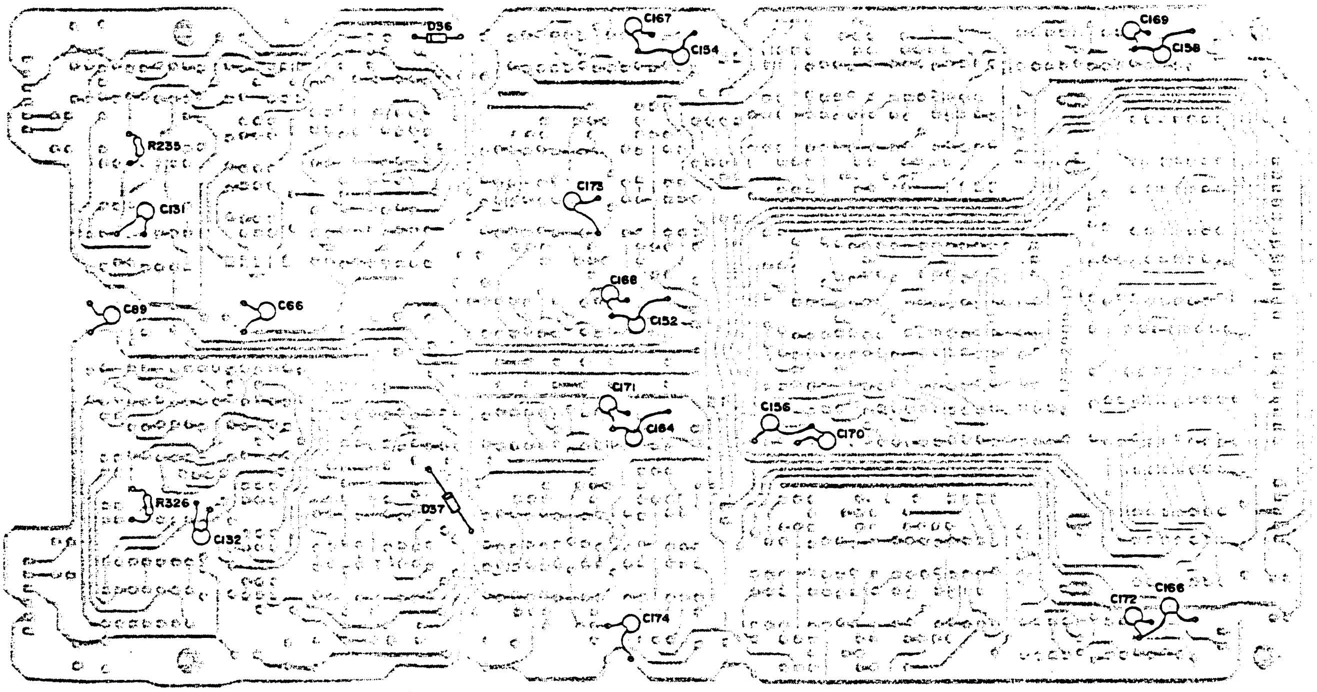


12-3

73-1320-00


C165
R314
C35
R86
C147
C83
D45
R196
R195
D46
D42
R308
D43
C141
D63
R313
R305
R315
C136
C180
C77
Q36
C26
C25
Q37
C143
R318
R324
R321
R319
R320
D44
R325
Q79
TH1
R317
R322
C51
R309
L12
R70
C142
R316
C135
C161
R316
C108
R58
R306
C138
C159
C80
C81
D38
R23
D40
D41
R307
R22
D39
C140
C34
R85
C146
C153
R310
C157
R312

(Parts Side View)

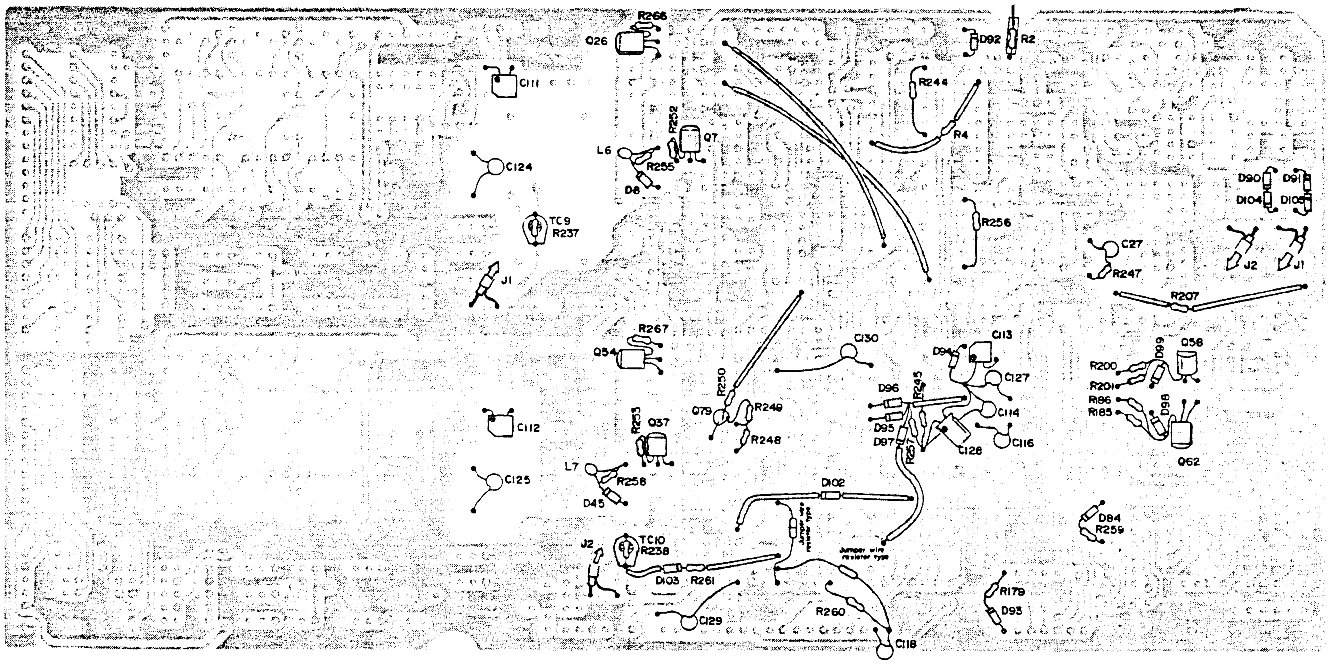

D36
C167
C154
C169
C158
R235
C131
C173
C89
C66
C168
C152
C171
C164
C156
C170
R326
C132
D37
C174
C172
C166

(Foil Side View)

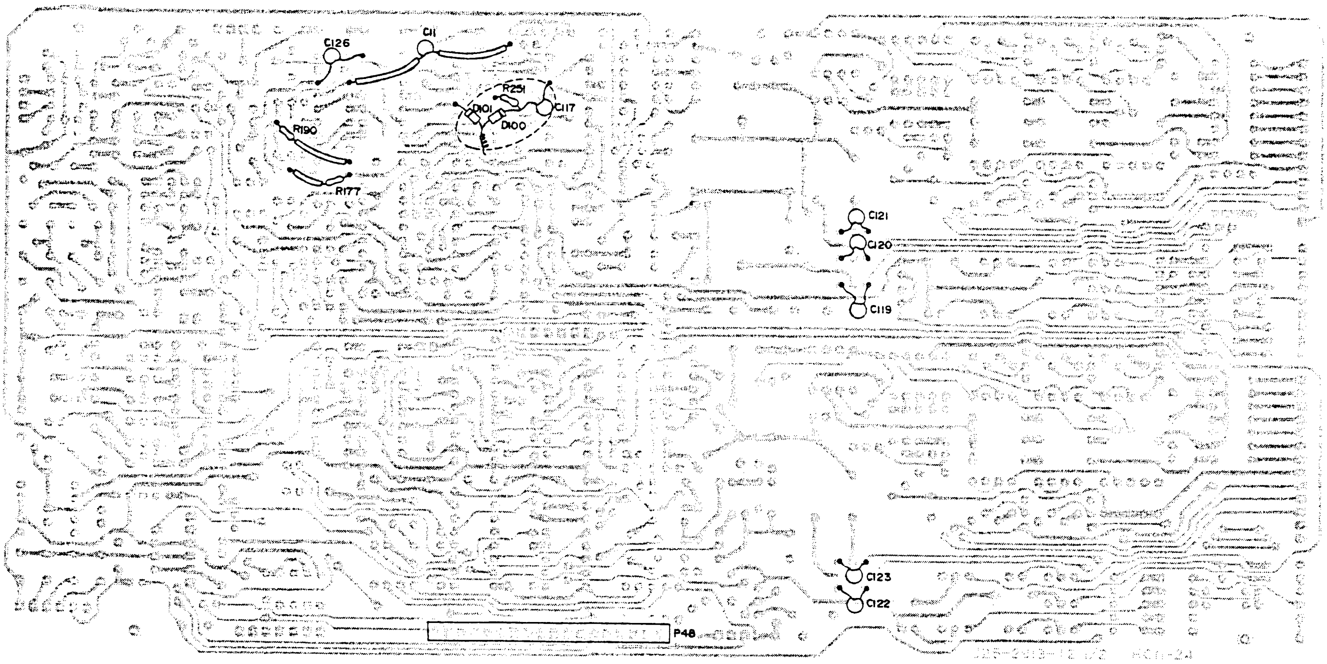
WAVEFORMS

12-9

X74-1220-00


R266
Q26
C111
D92
R2
R244
R4
R252
Q7
L6
R255
D8
C124
TC9
R237
J1
D90
D91
D104
D105
R256
C27
R247
J2
J1
R207
R267
Q54
C130
C113
D94
R245
D99
Q58
R200
C127
R201
R186
R185
D98
D96
C114
R250
Q79
R249
R248
R253
Q37
C112
D95
D97
R257
C116
C128
Q62
L7
R258
C125
D45
D102
D84
R259
J2
TC10
R238
D103
R261
Jumper wire resistor type
R179
D93
R260
C129
C118

(Parts Side View)

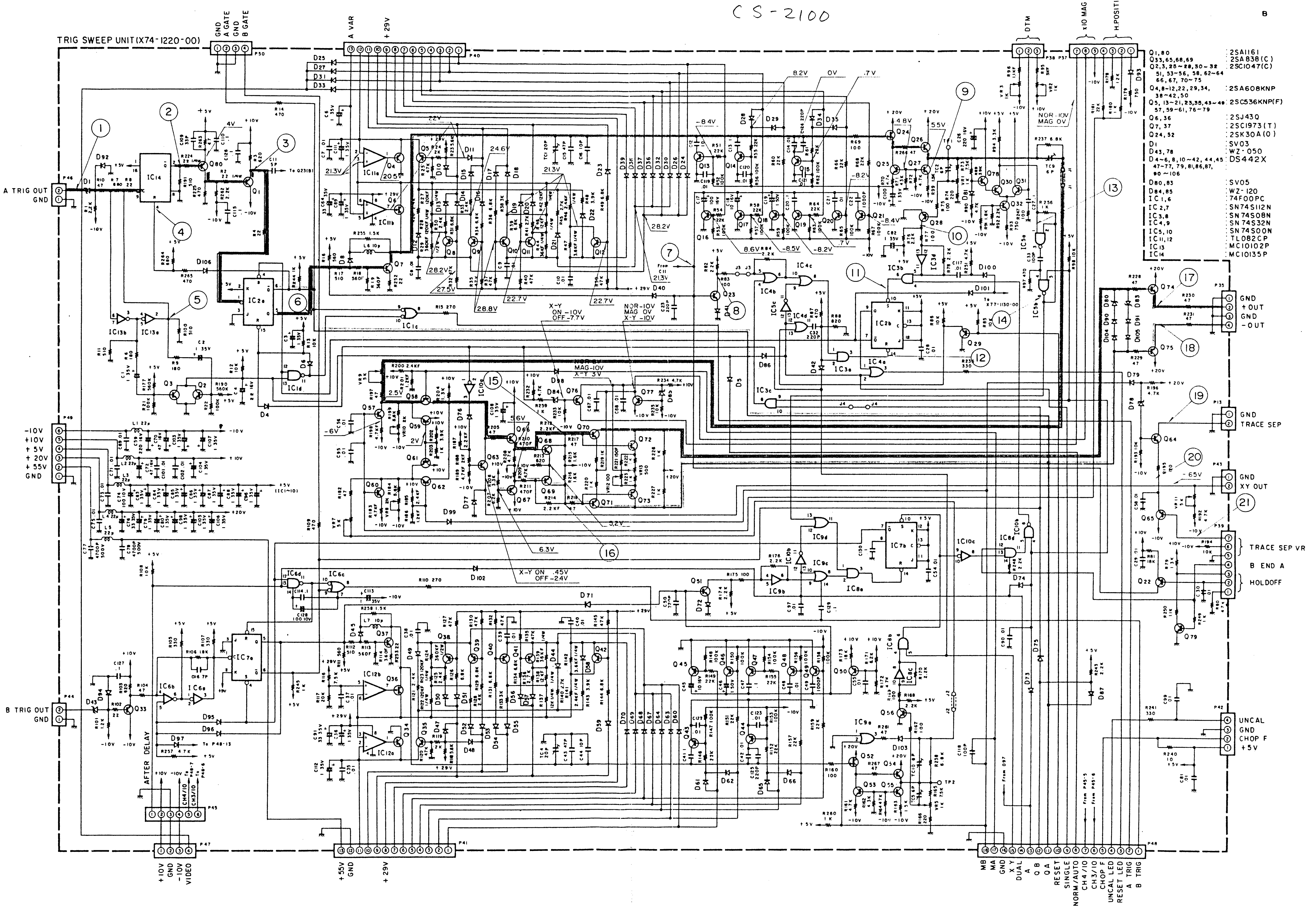

C126
C11
R251
C117
D101
D100
R190
R177
C121
C120
C119
C123
C122
P48

(Foil Side View)

12-10

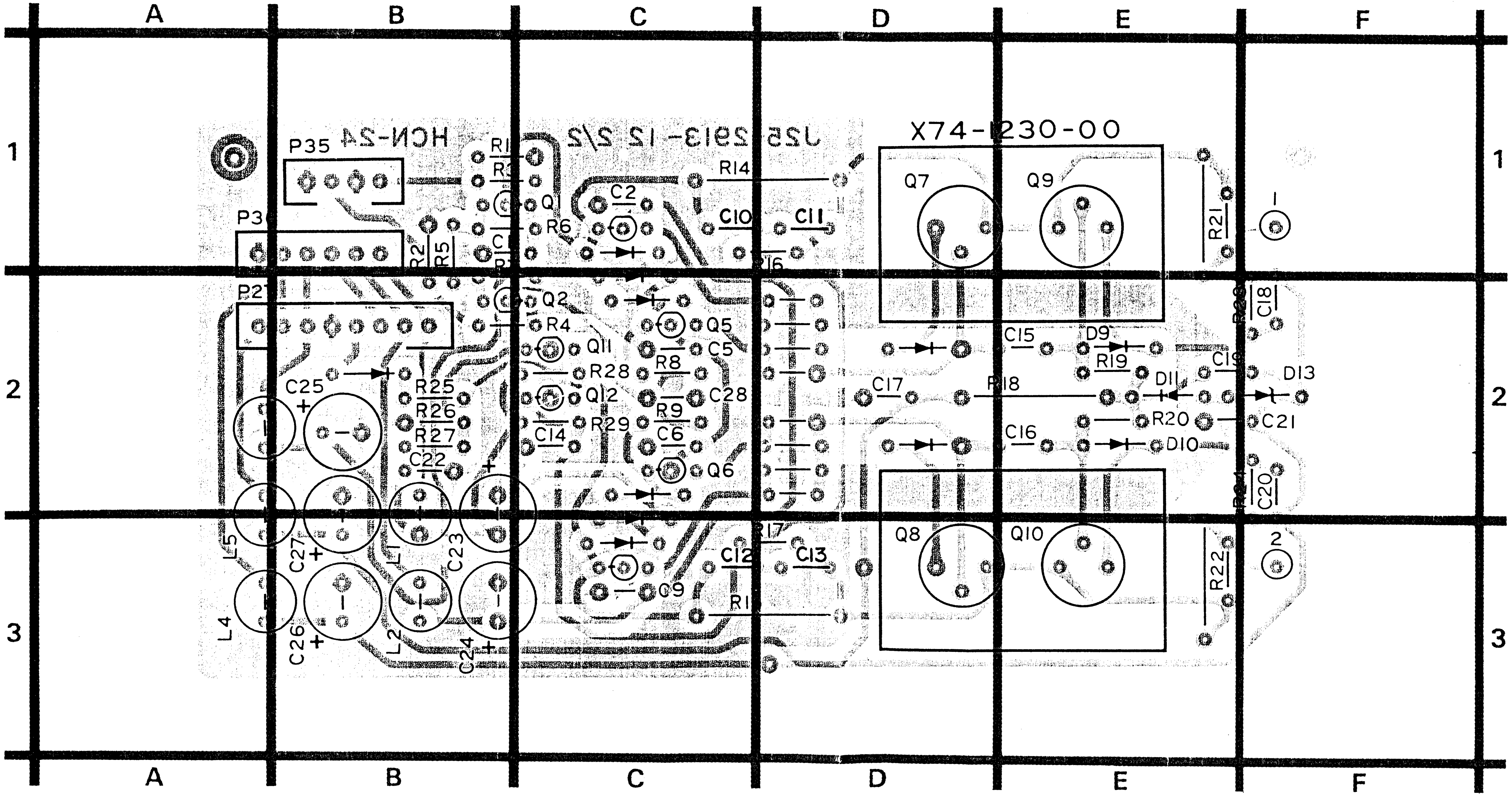
SCHEMATIC DIAGRAM

CS-2100


B
TRIG SWEEP UNIT (X74-1220-00)
GND
A GATE
GND
B GATE
P50
A VAR
+29V
P40
DTM
x10 MAG
H.POSITION
P38
P37
A TRIG OUT
GND
P46
-10V
+10V
+5V
+20V
+55V
GND
P49
B TRIG OUT
GND
P44
AFTER DELAY
P45
P47
+10V
GND
-10V
VIDEO
P41
+55V
GND
+29V
P48
MB
MA
GND
X-Y
DUAL
A
Q B
Q A
RESET
SINGLE
NORM/AUTO
CH4/10
CH3/10
CHOP F
UNCAL LED
RESET LED
A TRIG
B TRIG
P35
GND
+OUT
GND
-OUT
P13
GND
TRACE SEP
P43
GND
XY OUT
P39
TRACE SEP VR
B END A
HOLDOFF
P42
UNCAL
GND
CHOP F
+5V
X-Y ON -10V OFF -7.7V
NOR -10V MAG OV X-Y -10V
NOR 6V MAG -10V X-Y 3V
NOR -10V MAG OV
X-Y ON .45V OFF -24V
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21

Q1,80	2SA1161
Q33,65,68,69	2SA838(C)
Q2,3,25~28,30~32 51, 53~56, 58, 62~64 66, 67, 70~75	2SC1047(C)
Q4,8~12,22,29,34, 38~42,50	2SA608KNP
Q5, 13~21,23,35,43~49 57,59~61,76~79	2SC536KNP(F)
Q6,36	2SJ43Q
Q7,37	2SC1973(T)
Q24,52	2SK30A(0)
D1	SV03
D43,78	WZ-050
D4~6,8,10~42,44,45 47~77, 79,81,86,87, 90~106	DS442X
D80,83	SV05
D84,85	WZ-120
IC1,6	74F00PC
IC2,7	SN74S112N
IC3,8	SN74S08N
IC4,9	SN74S32N
IC5,10	SN74S00N
IC11,12	TL082CP
IC13	MC10102P
IC14	MC10135P

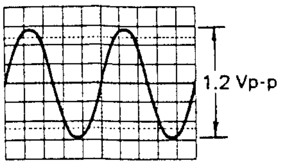
X74-1230-00



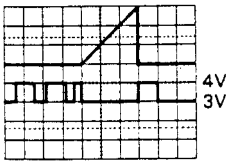
A
B
C
D
E
F
1
2
3
HCN-24
X74-1230-00
P35
P36
P21
R1
R3
Q1
R6
C1
R2
R5
R14
C2
C10
C11
R16
Q7
Q9
R21
1
Q2
R4
Q5
C5
Q11
R28
R8
Q12
R9
C28
R29
C6
C14
R25
R26
R27
C22
C25
C15
D9
R19
C17
R18
D11
C19
D13
R23
C18
R20
C21
C16
D10
R24
C20
Q6
Q8
Q10
R22
2
L5
C27
L1
C23
C12
R17
C13
C9
R15
L4
C26
L2
C24

WAVEFORMS

①

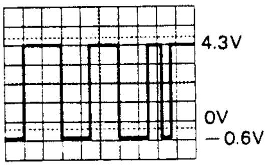


②



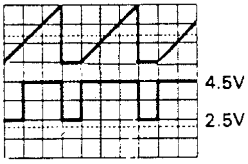
(Input signal: 2kHz)

③

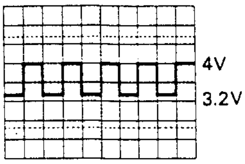


(Input signal: 2kHz)

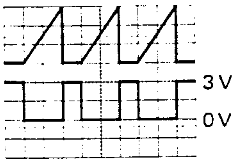
④



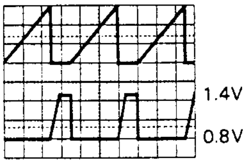
⑤



⑥



⑦



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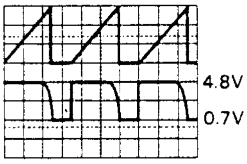
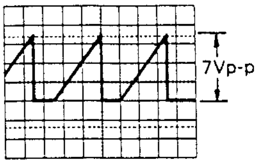


⑨



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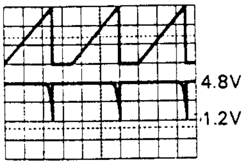

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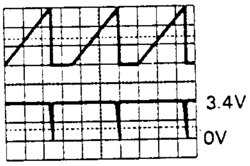
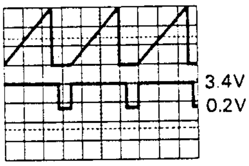
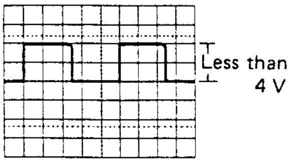


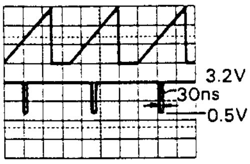
⑫



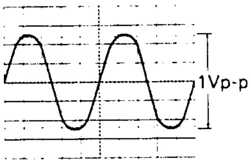
⑬



⑭

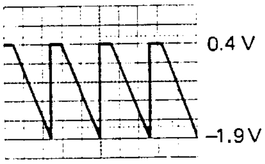


⑮-1

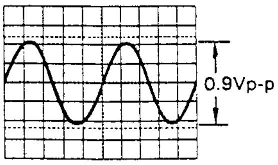


H.DISPLAY: X-Y

⑮-2

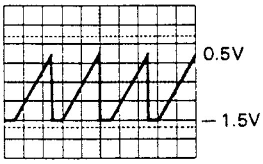


⑯-1

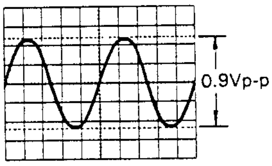


H. DISPLAY: X-Y

⑯-2

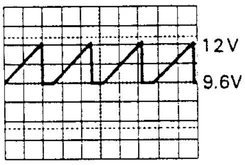


⑰-1

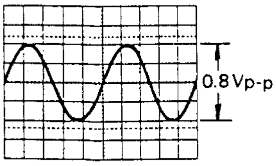


H. DISPLAY: X-Y

⑰-2

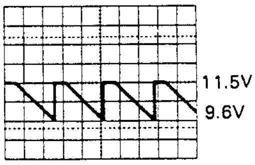


⑱-1

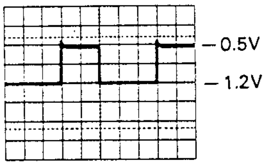


H.DISPLAY: X-Y

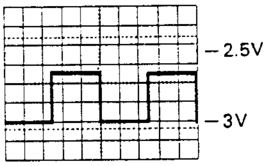
⑱-2



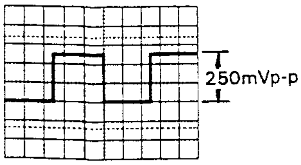
⑲



⑳

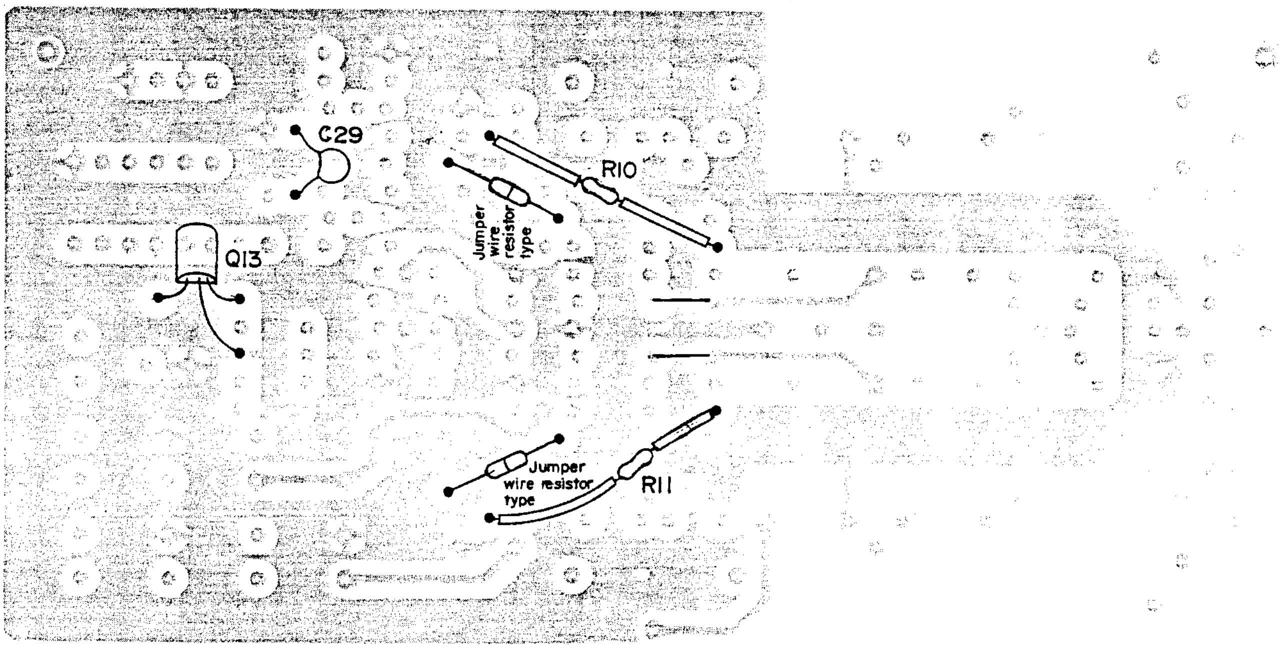


㉑

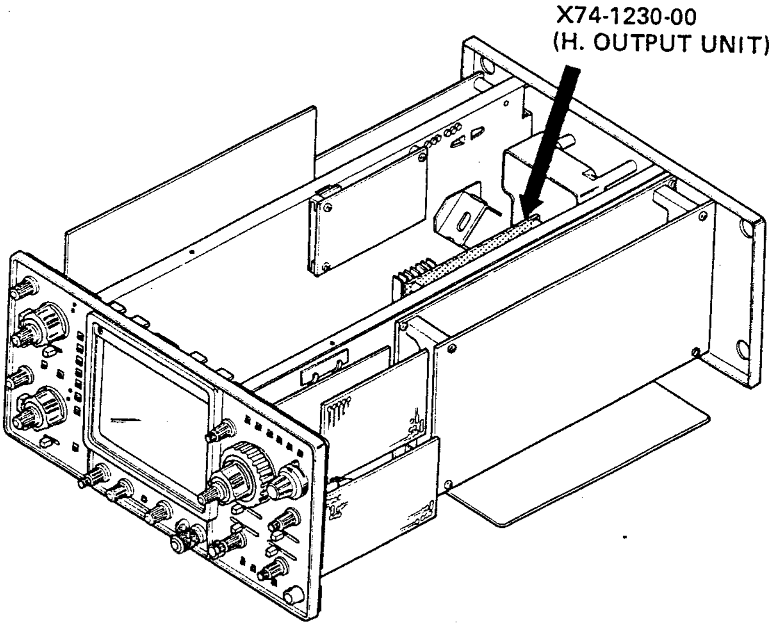


♦ TRACE SEP: MAX

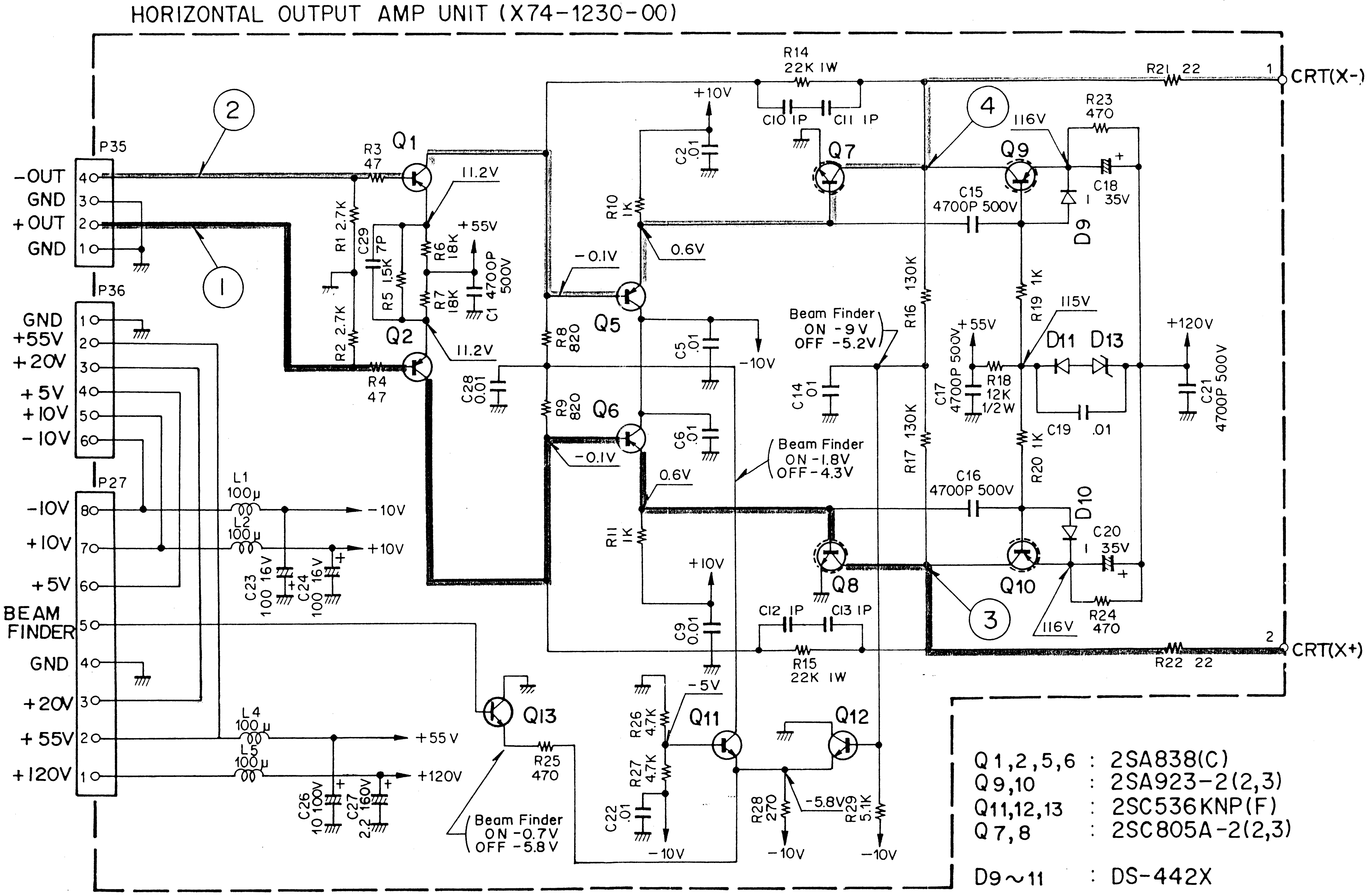
X74-1230-00


C29
R10
Jumper wire resistor type
Q13
Jumper wire resistor type
R11

(Parts Side View)


X74-1230-00
(H. OUTPUT UNIT)

SCHEMATIC DIAGRAM

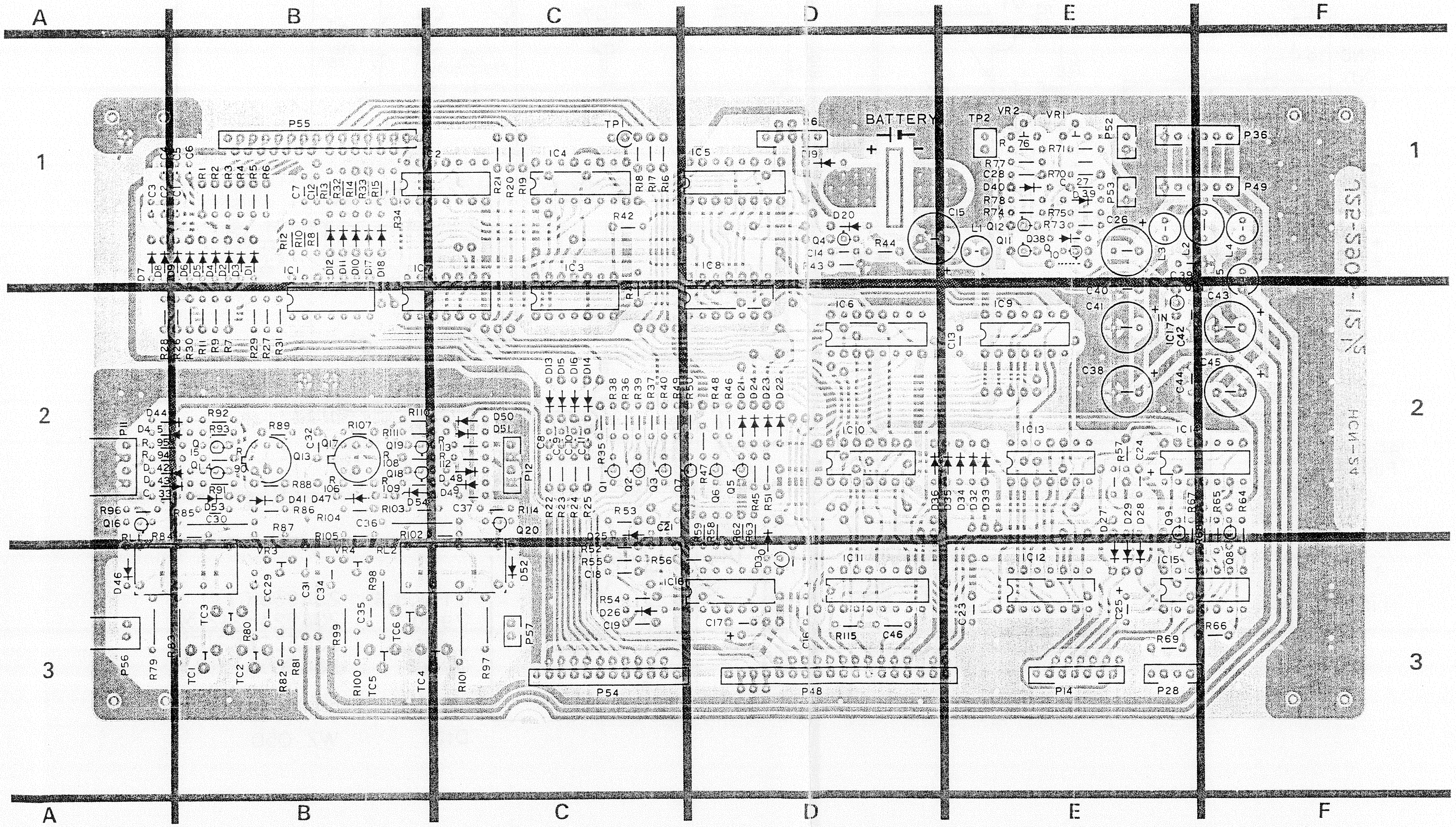

HORIZONTAL OUTPUT AMP UNIT (X74-1230-00)
P35
-OUT 4
GND 3
+OUT 2
GND 1
P36
GND 1
+55V 2
+20V 3
+5V 4
+10V 5
-10V 6
P27
-10V 8
+10V 7
+5V 6
BEAM FINDER 5
GND 4
+20V 3
+55V 2
+120V 1
②
①
③
④
Q1
R3 47
R1 2.7K
C29 7P
R5 1.5K
R2 2.7K
Q2
R4 47
11.2V
11.2V
R6 18K
R7 18K
+55V
C1 4700P 500V
C28 0.01
R8 820
R9 820
Q5
Q6
-0.1V
-0.1V
0.6V
0.6V
R10 1K
R11 1K
+10V
C2 .01
C5 .01
-10V
C6 .01
C9 0.01
+10V
R14 22K 1W
C10 1P
C11 1P
C12 1P
C13 1P
R15 22K 1W
Q7
Q8
Beam Finder
ON -9V
OFF -5.2V
Beam Finder
ON -1.8V
OFF -4.3V
C14 .01
R16 130K
R17 130K
C15 4700P 500V
C16 4700P 500V
C17 4700P 500V
+55V
R18 12K 1/2W
Q9
Q10
116V
116V
115V
R19 1K
R20 1K
D9
D10
D11
D13
C19 .01
R23 470
R24 470
C18 1 35V
C20 1 35V
+120V
C21 4700P 500V
R21 22
R22 22
1
2
CRT(X-)
CRT(X+)
L1 100µ
L2 100µ
-10V
+10V
C23 100 16V
C24 100 16V
L4 100µ
L5 100µ
+55V
+120V
C26 10 100V
C27 2.2 160V
Q13
R25 470
Beam Finder
ON -0.7V
OFF -5.8V
R26 4.7K
R27 4.7K
C22 .01
-5V
-10V
Q11
Q12
R28 270
R29 5.1K
-5.8V
-10V
-10V

Q1,2,5,6 : 2SA838(C)
Q9,10 : 2SA923-2(2,3)
Q11,12,13 : 2SC536KNP(F)
Q7,8 : 2SC805A-2(2,3)

D9~11 : DS-442X
D13 : WZ-050

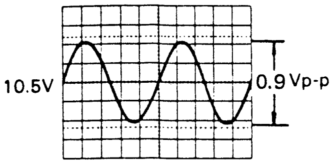
PC BOARD

X77-1130-00


A
B
C
D
E
F
1
2
3
P55
P36
P49
P52
P53
P54
P48
P14
P28
P56
P57
P11
P12
BATTERY
TP1
TP2
VR1
VR2
VR3
VR4
IC1
IC2
IC3
IC4
IC5
IC6
IC8
IC9
IC10
IC11
IC12
IC13
IC14
IC15
IC16
IC17
RL1
RL2
TC1
TC2
TC3
TC4
TC5
TC6
L1
L2
L3
L4
C15
C26
C38
C40
C41
C42
C43
C44
C45
Q13
Q17
Q20
X-15 S-200

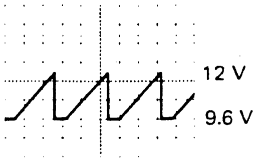
WAVEFORMS

①-1

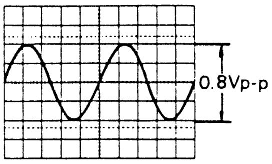


H.DISPLAY: X-Y

①-2

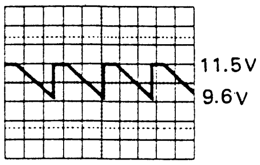


②-1

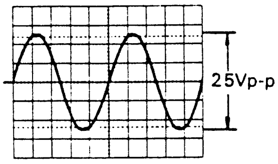


H.DISPLAY :X-Y

②-2

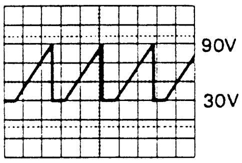


③-1 ④-1

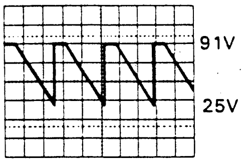


H.DISPLAY: X-Y

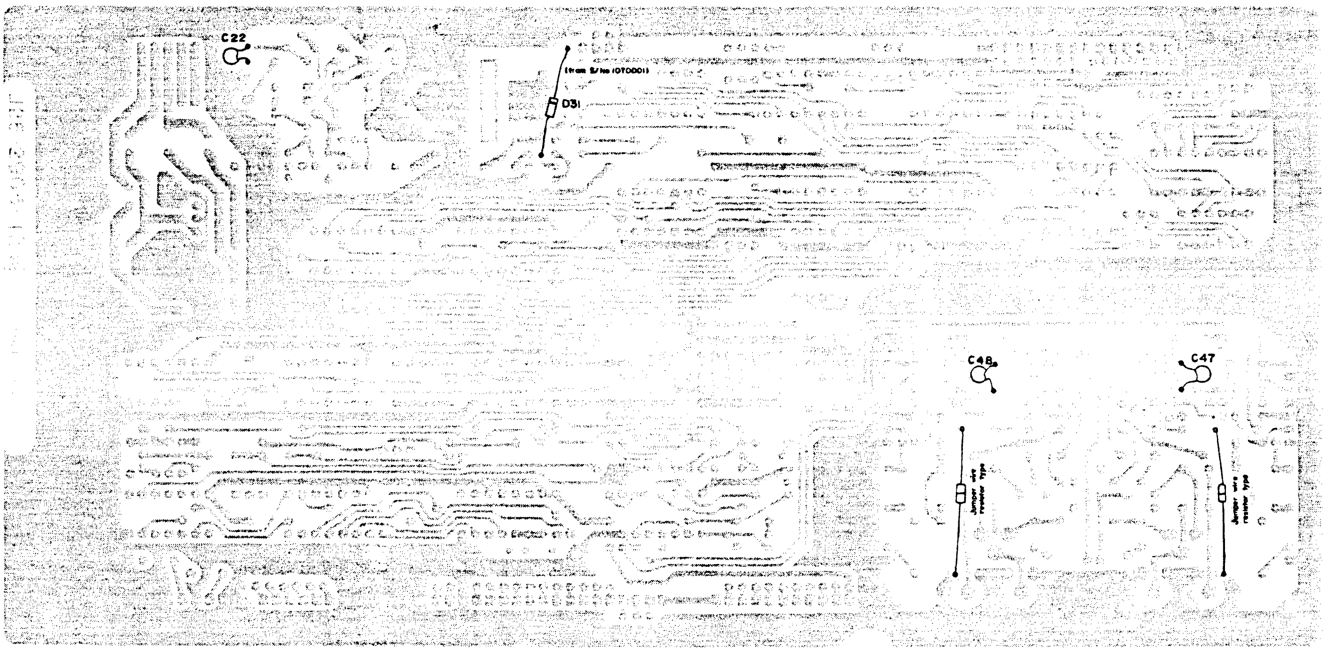
③-2



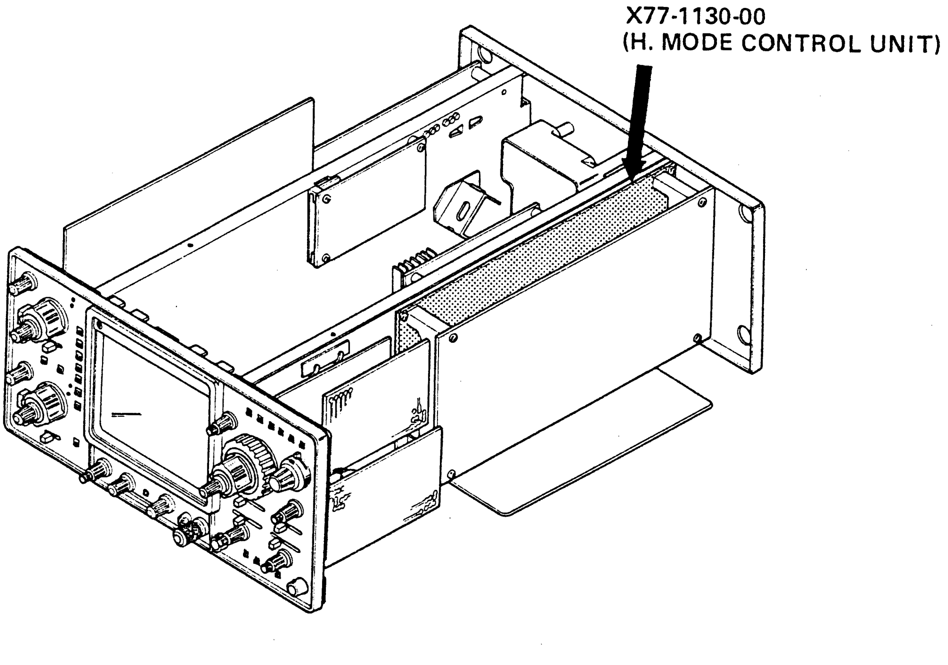
④-2



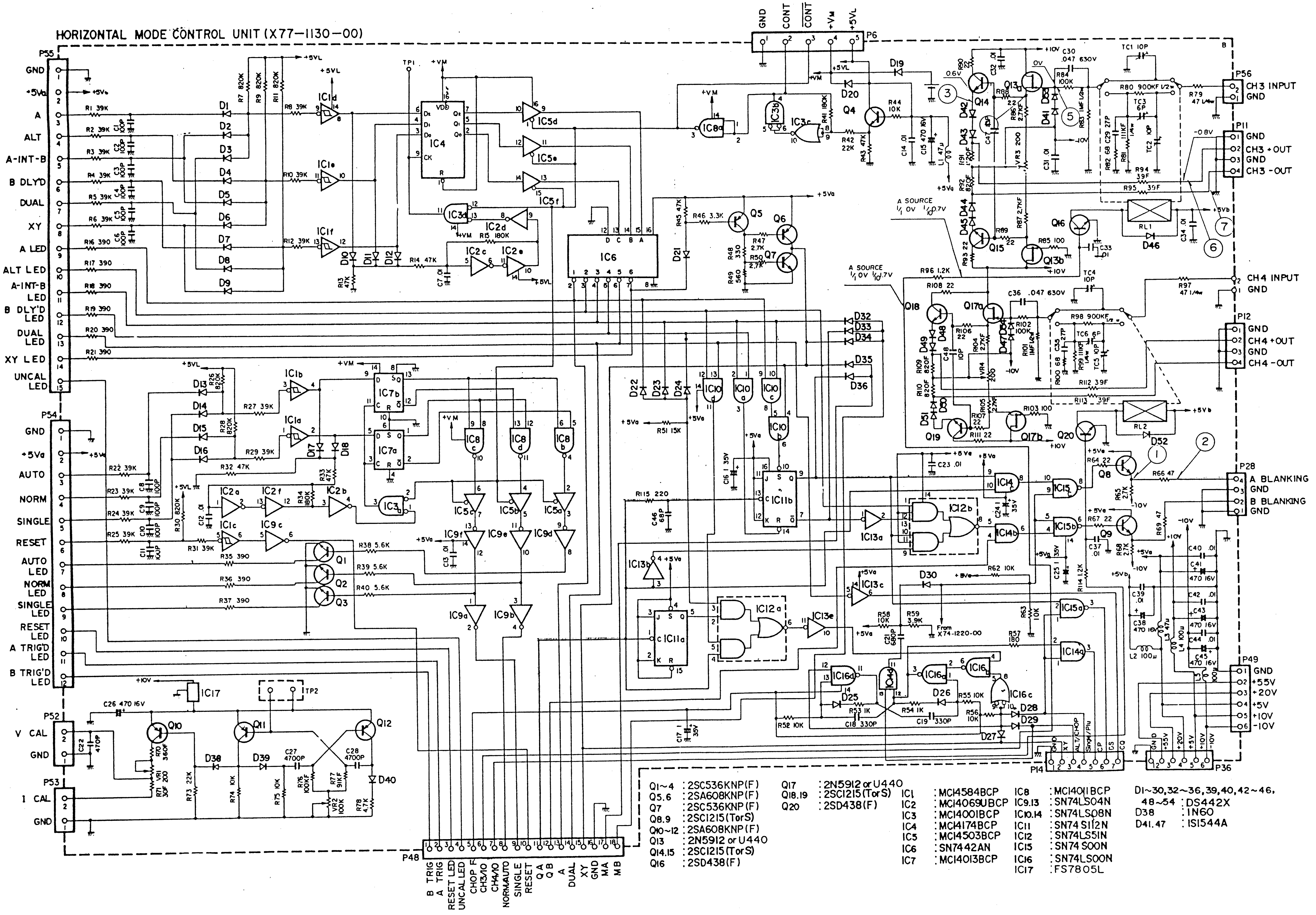
X77-1130-00


C22
(from S/No 070001)
D31
C48
C47
Jumper wire resistor type
Jumper wire resistor type

(Foil Side View)


X77-1130-00
(H. MODE CONTROL UNIT)

SCHEMATIC DIAGRAM



HORIZONTAL MODE CONTROL UNIT (X77-1130-00)

P55
GND
+5Va
A
ALT
A-INT-B
B DLY'D
DUAL
XY
A LED
ALT LED
A-INT-B LED
B DLY'D LED
DUAL LED
XY LED
UNCAL LED
P54
GND
+5Va
AUTO
NORM
SINGLE
RESET
AUTO LED
NORM LED
SINGLE LED
RESET LED
A TRIG'D LED
B TRIG'D LED
P52
V CAL
GND
P53
I CAL
GND
P6
GND
CONT
CONT
+VM
+5VL
P56
CH3 INPUT
GND
P11
GND
CH3 +OUT
GND
CH3 -OUT
CH4 INPUT
GND
P12
GND
CH4 +OUT
GND
CH4 -OUT
P28
A BLANKING
GND
B BLANKING
GND
P49
GND
+55V
+20V
+5V
+10V
-10V
P14
GND
XY
ALT/CHOP
Single/Plu
CP
CS
CQ
P36
P48
B TRIG
A TRIG
RESET LED
UNCAL LED
CHOP F
CH3/10
CH4/10
NORM AUTO
SINGLE
RESET
QA
QB
A
DUAL
XY
GND
MA
MB
IC1a
IC1b
IC1c
IC1d
IC1e
IC1f
IC2a
IC2b
IC2c
IC2d
IC2e
IC2f
IC3a
IC3b
IC3c
IC3d
IC4
IC5a
IC5b
IC5c
IC5d
IC5e
IC5f
IC6
IC7a
IC7b
IC8a
IC8b
IC8c
IC8d
IC9a
IC9b
IC9c
IC9d
IC9e
IC9f
IC10a
IC10b
IC10c
IC10d
IC11a
IC11b
IC12a
IC12b
IC13a
IC13b
IC13c
IC13e
IC14a
IC14b
IC14c
IC14d
IC15a
IC15b
IC16a
IC16b
IC16c
IC16d
IC17
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Q16
Q17a
Q17b
Q18
Q19
Q20
RL1
RL2
TP1
TP2
A SOURCE
1/1 0V 1/10 0.7V
From X74-1220-00
-0.8V
0.6V
0V
①
②
③
⑤
⑥
⑦

Q1~4 : 2SC536KNP(F)
Q5.6 : 2SA608KNP(F)
Q7 : 2SC536KNP(F)
Q8.9 : 2SC1215(TorS)
Q10~12 : 2SA608KNP(F)
Q13 : 2N5912 or U440
Q14.15 : 2SC1215(TorS)
Q16 : 2SD438(F)

Q17 : 2N5912 or U440
Q18.19 : 2SC1215(TorS)
Q20 : 2SD438(F)

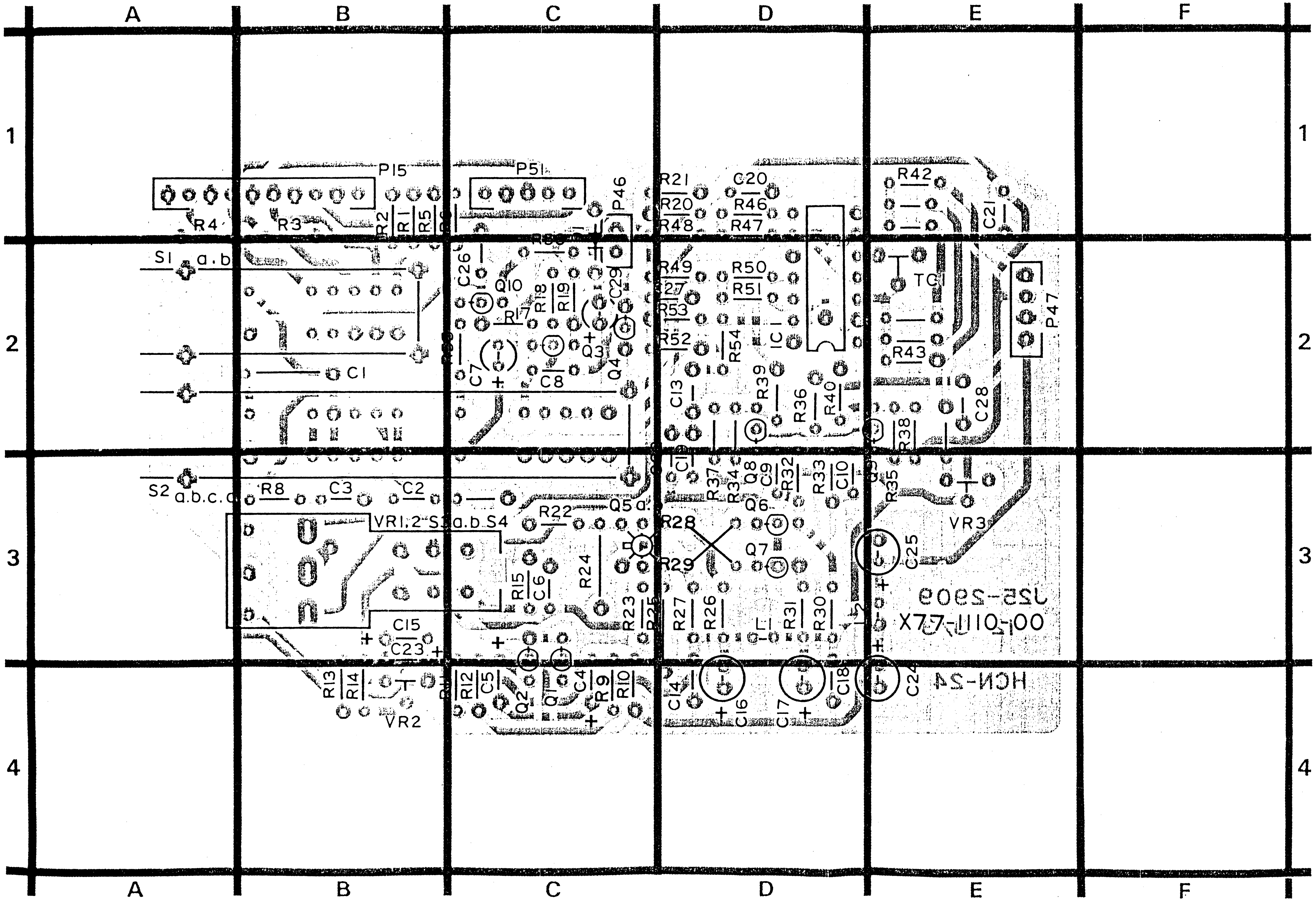
IC1 : MC14584BCP
IC2 : MC14069UBCP
IC3 : MC14001BCP
IC4 : MC14174BCP
IC5 : MC14503BCP
IC6 : SN7442AN
IC7 : MC14013BCP

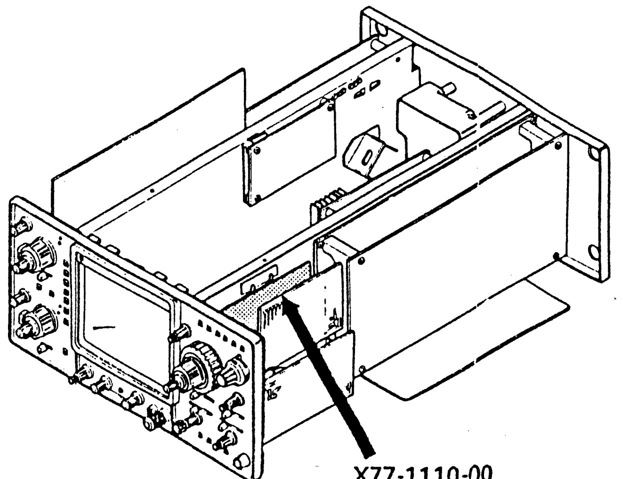
IC8 : MC14011BCP
IC9.13 : SN74LS04N
IC10.14 : SN74LS08N
IC11 : SN74S112N
IC12 : SN74LS51N
IC15 : SN74S00N
IC16 : SN74LS00N
IC17 : FS7805L

D1~30,32~36,39,40,42~46,
48~54 : DS442X
D38 : 1N60
D41.47 : 1S1544A

PC BOARD

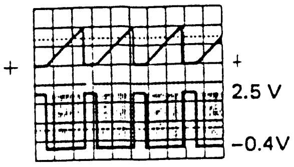
X77-1110-00


A
B
C
D
E
F
1
2
3
4
P15
P51
P46
P47
R21
C20
R42
R20
R46
R48
R47
C21
R4
R3
R2
R1
R5
S1
a.b
C26
Q10
R18
R19
C29
R49
R50
R51
TC1
R17
R53
R27
R52
IC1
R54
R43
C7
C8
Q3
Q4
C1
R39
R36
R40
C13
C28
R38
C12
R37
R34
Q8
C9
R32
R33
C10
R35
S2
a.b.c.d
R8
C3
C2
R22
Q5
VR1,2
S3 a.b
S4
R28
Q6
Q7
R29
C25
VR3
R24
R15
C6
R23
R25
R27
R26
L1
R31
R30
J25-2909
X77-1110-00
C15
C23
R13
R14
VR2
R11
R12
C5
Q2
Q1
C4
R9
R10
C14
C16
C17
C18
C24
HCN-24

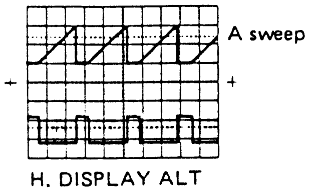


WAVEFORMS

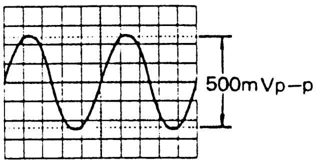
①



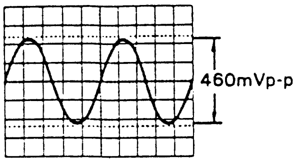
②



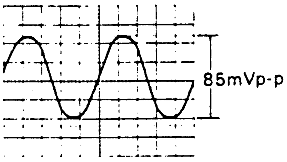
⑤



③④⑥

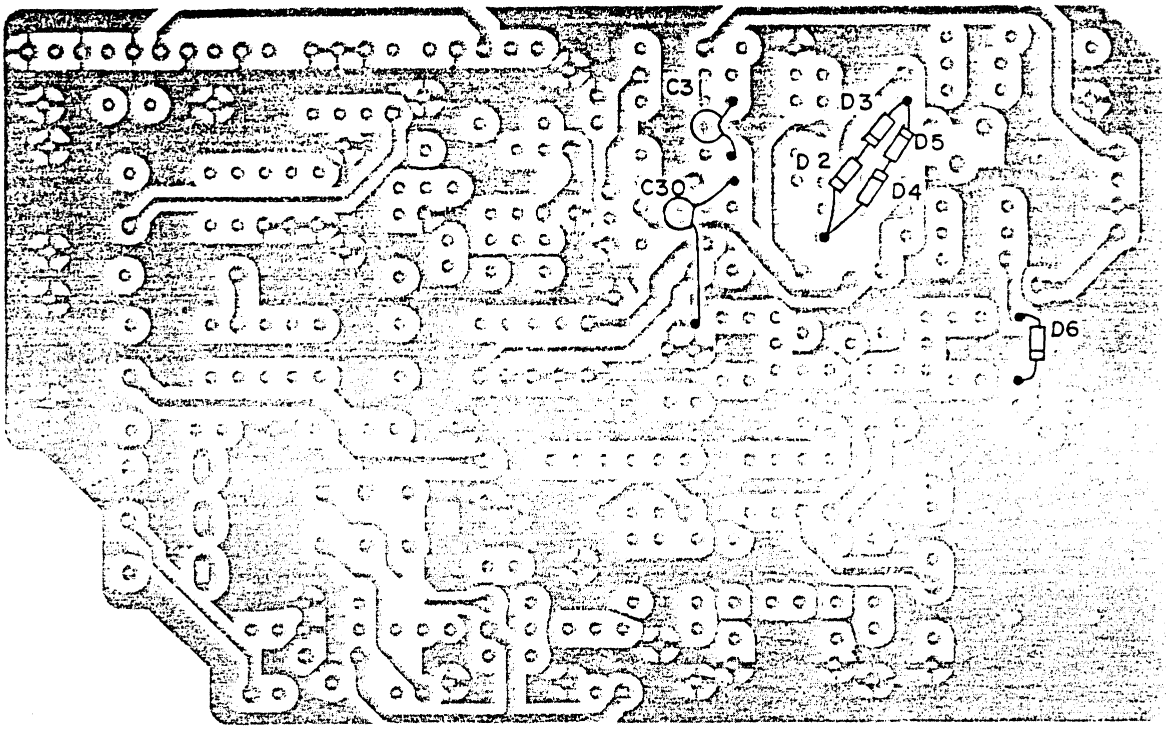


⑦

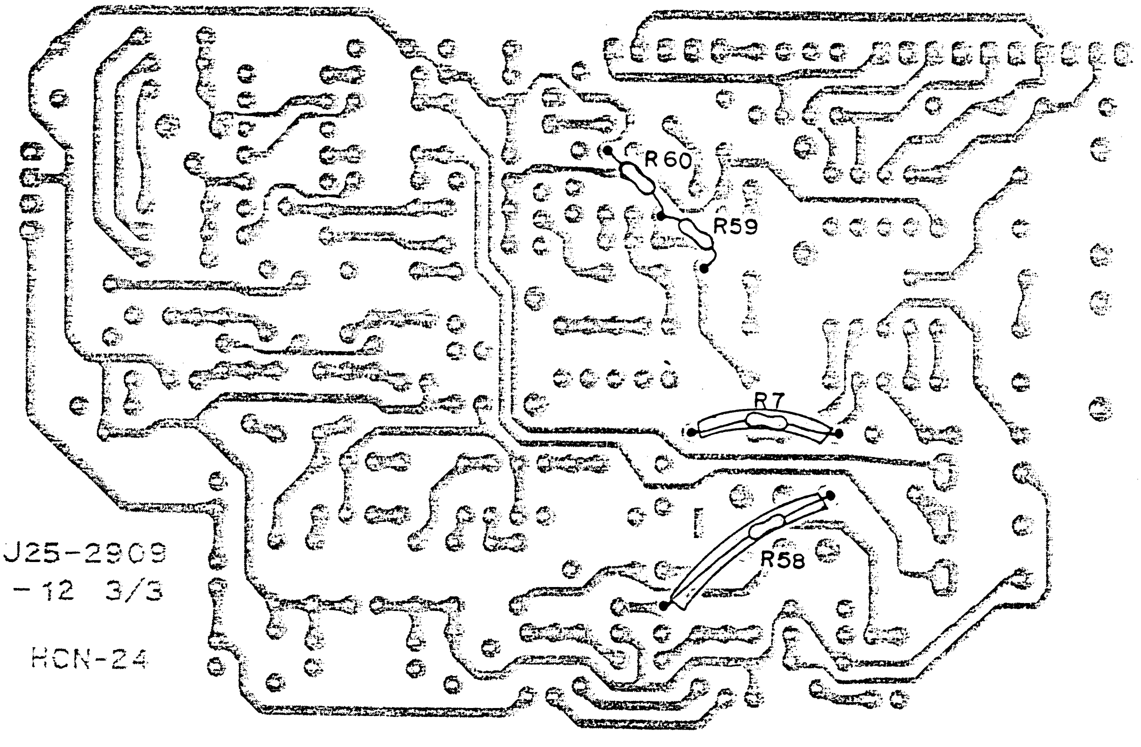


12-15

7-1110-00


C3
D3
D5
D 2
D4
C30
D6

(Parts Side View)

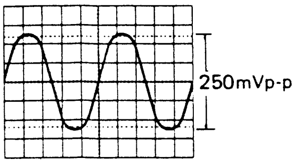

R 60
R59
R7
R58
J25-2909
-12 3/3
HCN-24

(Foil Side View)

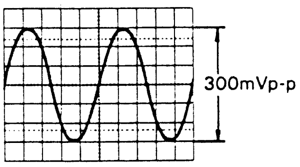
c

WAVEFORMS

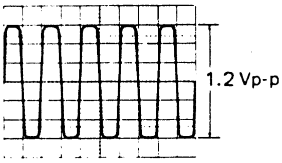
①



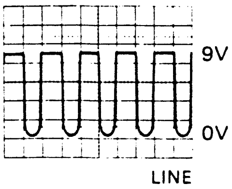
②



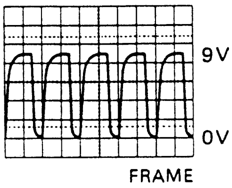
③



④-1

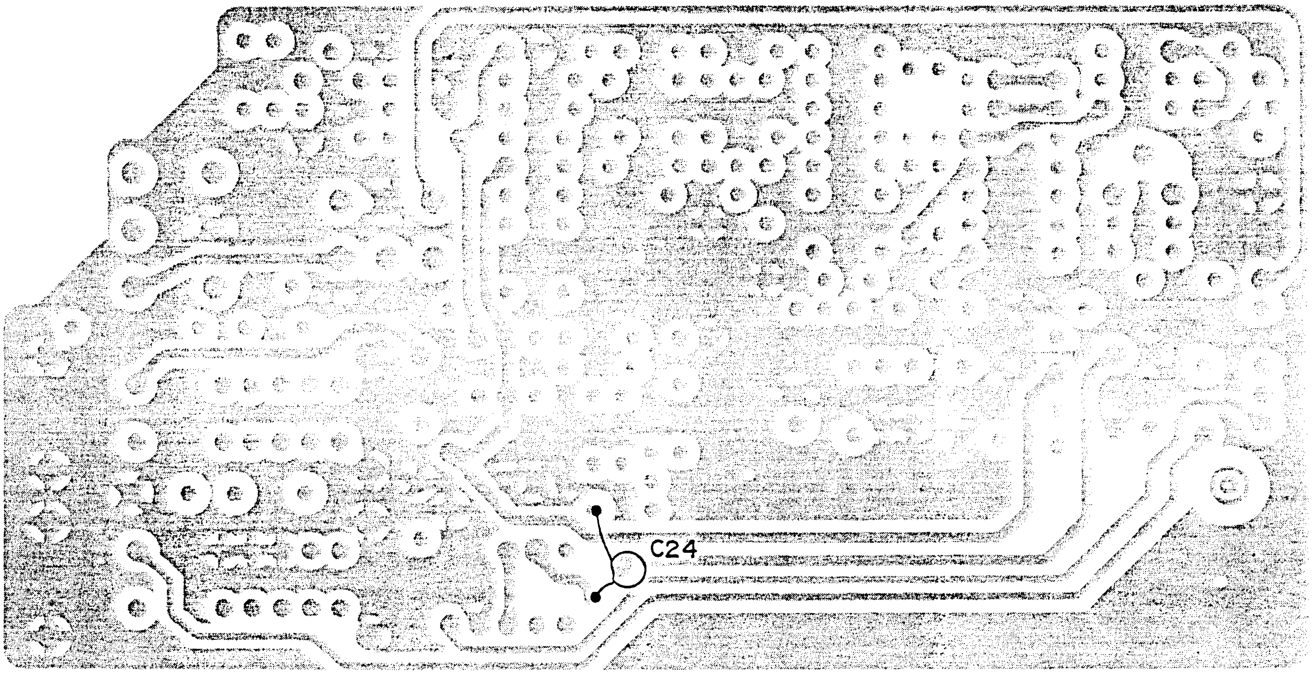


④-2

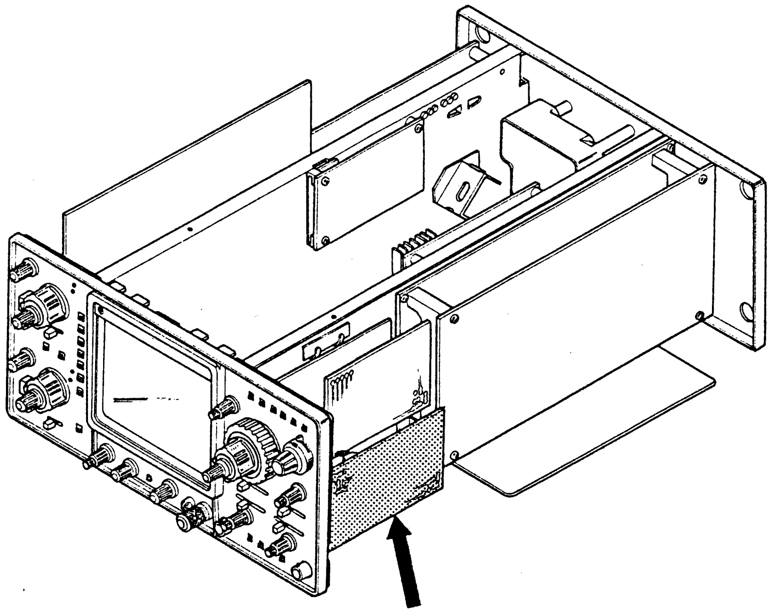


12-17

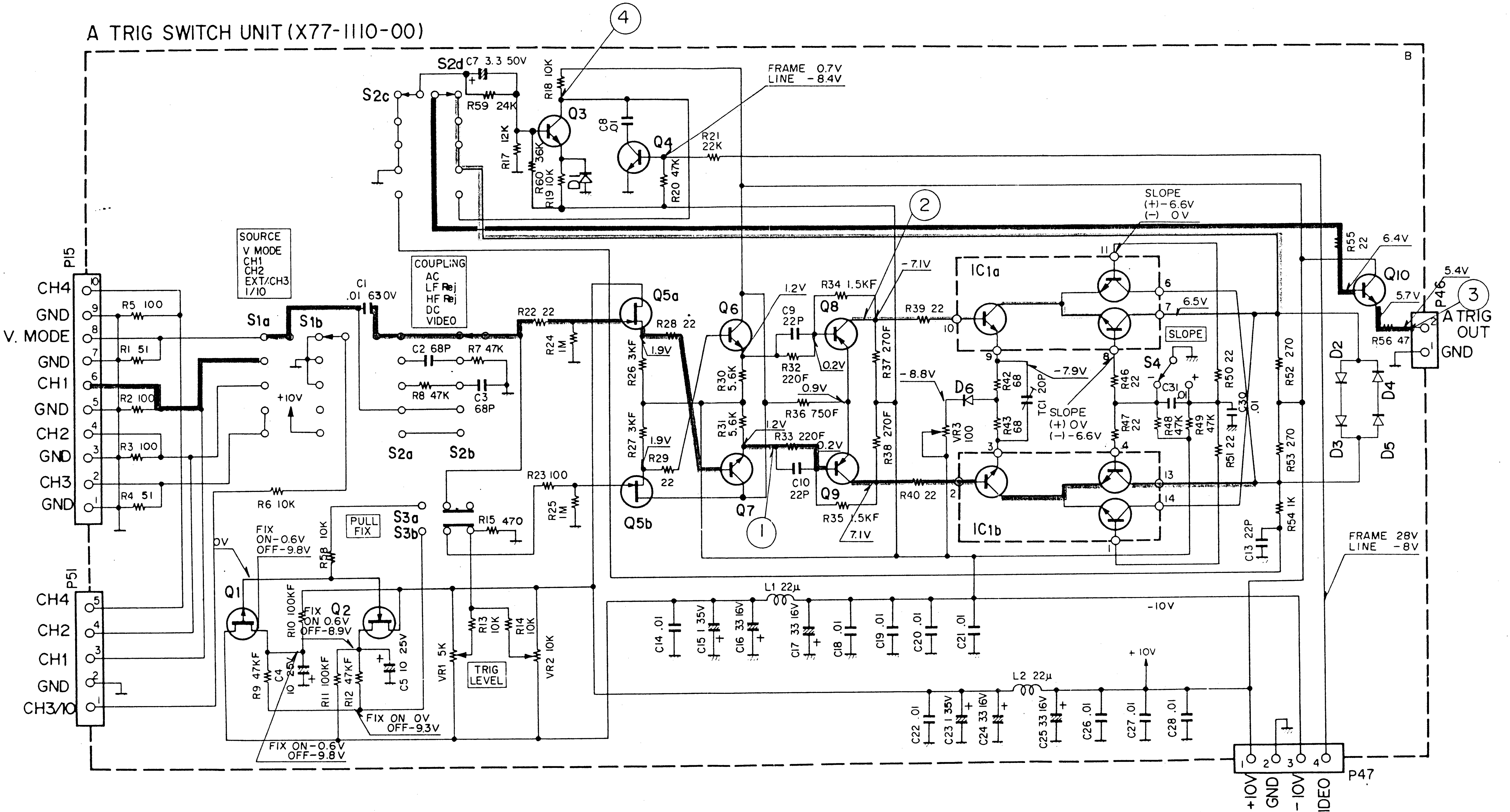
X77-1120-00



(Foil Side View)


X77-1120-00
(B TRIG UNIT)

A TRIG SWITCH UNIT (X77-1110-00)

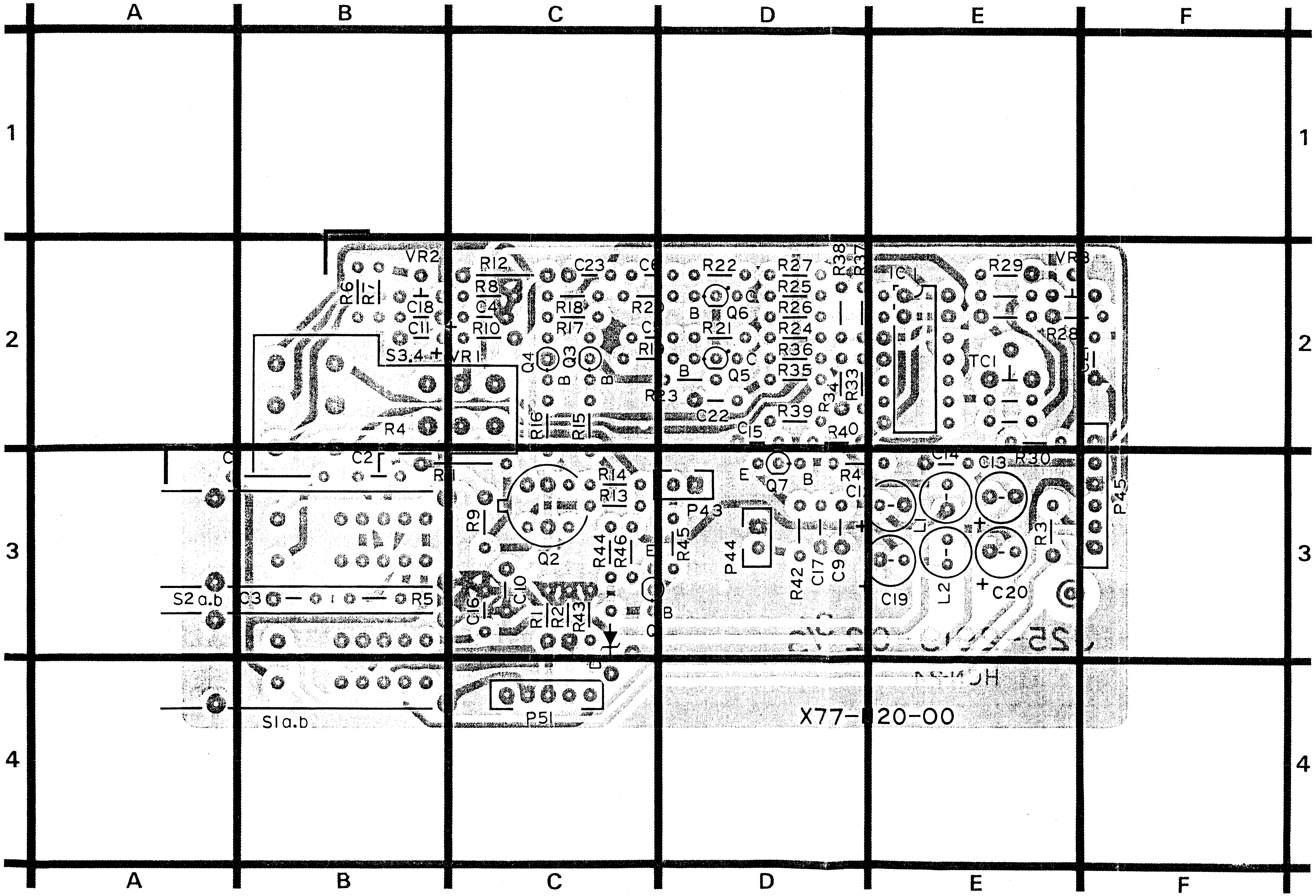


④
B
S2d
C7 3.3 50V
S2c
R59 24K
R18 10K
Q3
C8 .01
Q4
FRAME 0.7V
LINE -8.4V
R21 22K
R17 12K
R60 36K
R19 10K
D1
R20 47K
②
SLOPE
(+) -6.6V
(-) 0V
R55 22
6.4V
Q10
5.4V
5.7V
P46
③
A TRIG OUT
GND
R56 47
SOURCE
V MODE
CH1
CH2
EXT/CH3
1/10
COUPLING
AC
LF Rej
HF Rej
DC
VIDEO
C1 .01 630V
P15
CH4
GND
V. MODE
GND
CH1
GND
CH2
GND
CH3
GND
R5 100
R1 51
R2 100
R3 100
R4 51
R6 10K
S1a
S1b
+10V
S2a
S2b
C2 68P
R7 47K
R8 47K
C3 68P
R22 22
R24 1M
Q5a
Q5b
R28 22
R26 3KF
R27 3KF
1.9V
1.9V
R29 22
R23 100
R25 1M
Q6
Q7
1.2V
1.2V
C9 22P
R32 220F
R30 5.6K
R31 5.6K
R33 220F
C10 22P
0.2V
0.2V
0.9V
R36 750F
Q8
Q9
R34 1.5KF
R35 1.5KF
-7.1V
7.1V
R37 270F
R38 270F
R39 22
R40 22
-8.8V
D6
VR3 100
R42 68
R43 68
TC1 20P
-7.9V
SLOPE
(+) 0V
(-) -6.6V
IC1a
IC1b
S4
SLOPE
C31 .01
R46 22
R47 22
R48 47K
R49 47K
R50 22
R51 22
C30 .01
R52 270
R53 270
R54 1K
C13 22P
D2
D3
D4
D5
FRAME 28V
LINE -8V
①
PULL FIX
S3a
S3b
R15 470
0V
FIX
ON -0.6V
OFF -9.8V
R58 10K
Q1
Q2
R10 100KF
FIX
ON 0.6V
OFF -8.9V
R9 47KF
C4 10 25V
R11 100KF
R12 47KF
C5 10 25V
FIX ON 0V
OFF -9.3V
FIX ON -0.6V
OFF -9.8V
R13 10K
R14 10K
VR1 5K
VR2 10K
TRIG LEVEL
P51
CH4
CH2
CH1
GND
CH3/10
L1 22μ
-10V
C14 .01
C15 1 35V
C16 33 16V
C17 33 16V
C18 .01
C19 .01
C20 .01
C21 .01
L2 22μ
+10V
C22 .01
C23 1 35V
C24 33 16V
C25 33 16V
C26 .01
C27 .01
C28 .01
P47
+10V
GND
-10V
VIDEO

IC1 :CA3102E
Q1 :2SJ43(Q)   D1~6 :DS442X
Q3,4 :2SC536KNP(F)
Q5 :2N5912 or U440
Q6,7 :2SC1215(T or S)
Q8,9 :2SA1161
Q2 :2SK127(Q)
Q10 :2SC2499

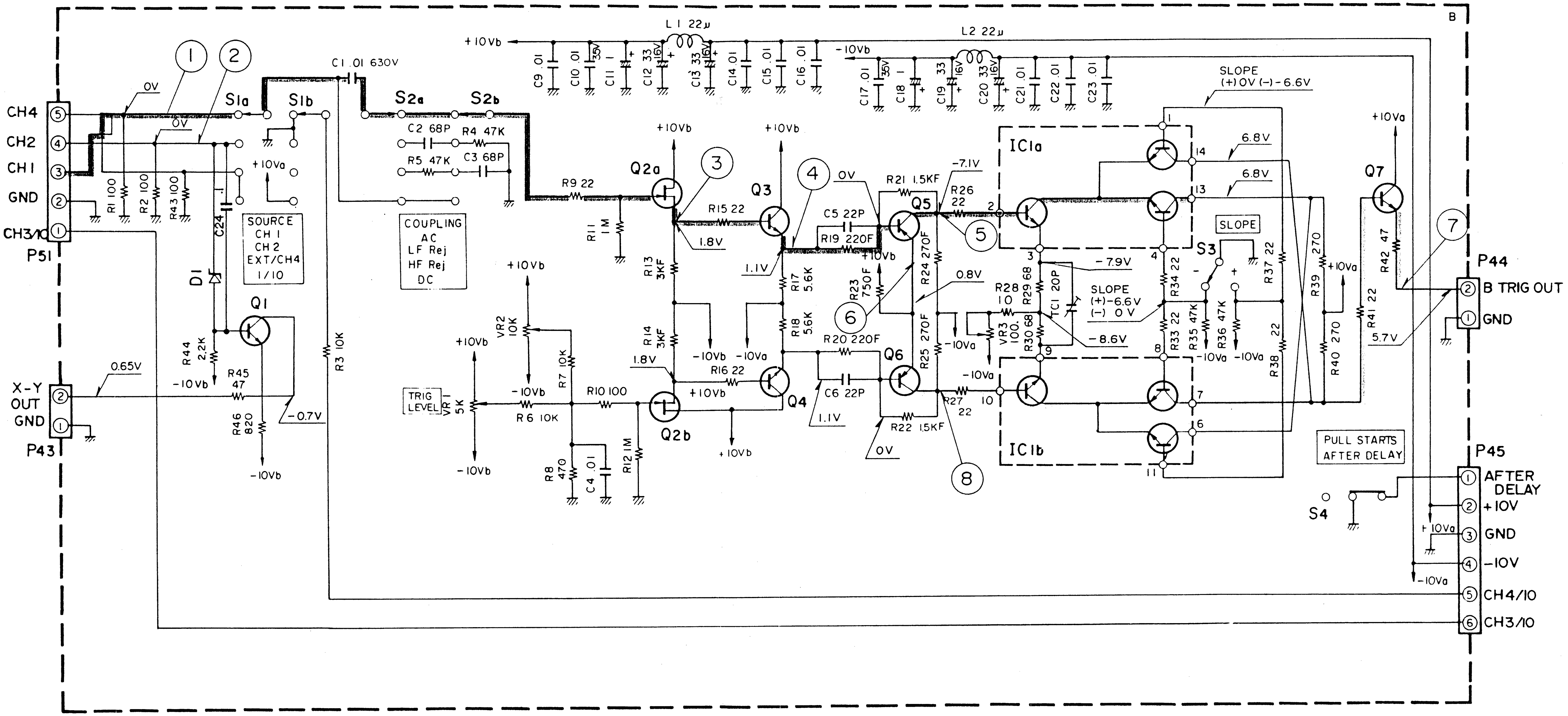
PC BOARD

X77-1120-00


A
B
C
D
E
F
1
2
3
4
VR2
R12
C23
C6
R22
R27
R38
R37
TC1
R29
VR3
R6
R7
C18
C11
R8
C4
R10
R18
R17
R20
Q6
R25
R26
R24
R36
R35
R21
Q5
R28
S3.4
VR1
Q4
Q3
B
C
E
R19
R33
R34
R23
C22
R39
R40
R16
R15
R4
C15
C1
C2
R11
R14
R13
P43
E
Q7
B
R41
C12
C14
C13
R30
P45
R9
Q2
R44
R46
R45
P44
R42
C17
C9
L1
C19
L2
C20
R3
S2 a.b
C3
R5
C16
C10
R1
R2
R43
D1
P51
S1 a.b
X77-1120-00

SCHEMATIC DIAGRAM

B TRIG SWITCH UNIT (X77-1120-00)


B
CH4
CH2
CH1
GND
CH3/10
P51
0V
S1a
S1b
C1 .01 630V
S2a
S2b
C2 68P
R4 47K
R5 47K
C3 68P
+10Va
SOURCE
CH 1
CH 2
EXT/CH4
1/10
COUPLING
AC
LF Rej
HF Rej
DC
R1 100
R2 100
R43 100
C24
D1
Q1
R44 2.2K
R45 47
R46 820
-10Vb
R3 10K
0.65V
-0.7V
X-Y OUT
GND
P43
+10Vb
L1 22μ
C9 .01
C10 .01
C11 1
C12 33 16V
C13 33 16V
C14 .01
C15 .01
C16 .01
-10Vb
L2 22μ
C17 .01
C18 1
C19 33 16V
C20 33 16V
C21 .01
C22 .01
C23 .01
R9 22
Q2a
Q2b
R11 1M
R13 3KF
R14 3KF
R15 22
R16 22
1.8V
Q3
Q4
VR2 10K
VR1 5K
TRIG LEVEL
R6 10K
R7 10K
R8 470
C4 .01
R10 100
R12 1M
R17 5.6K
R18 5.6K
1.1V
C5 22P
C6 22P
R19 220F
R20 220F
R21 1.5KF
R22 1.5KF
R23 750F
R24 270F
R25 270F
R26 22
R27 22
Q5
Q6
-7.1V
0.8V
R28 10
R29 68
R30 68
VR3 100
TC1 20P
-7.9V
-8.6V
SLOPE (+)-6.6V (-) 0V
IC1a
IC1b
6.8V
SLOPE (+) 0V (-) -6.6V
S3
SLOPE
R33 22
R34 22
R35 47K
R36 47K
R37 22
R38 22
R39 270
R40 270
R41 22
R42 47
Q7
5.7V
P44
B TRIG OUT
GND
PULL STARTS AFTER DELAY
S4
P45
AFTER DELAY
+10V
GND
-10V
CH4/10
CH3/10
1
2
3
4
5
6
7
8

IC1 : CA3102E   Q5,6 : 2SA1161

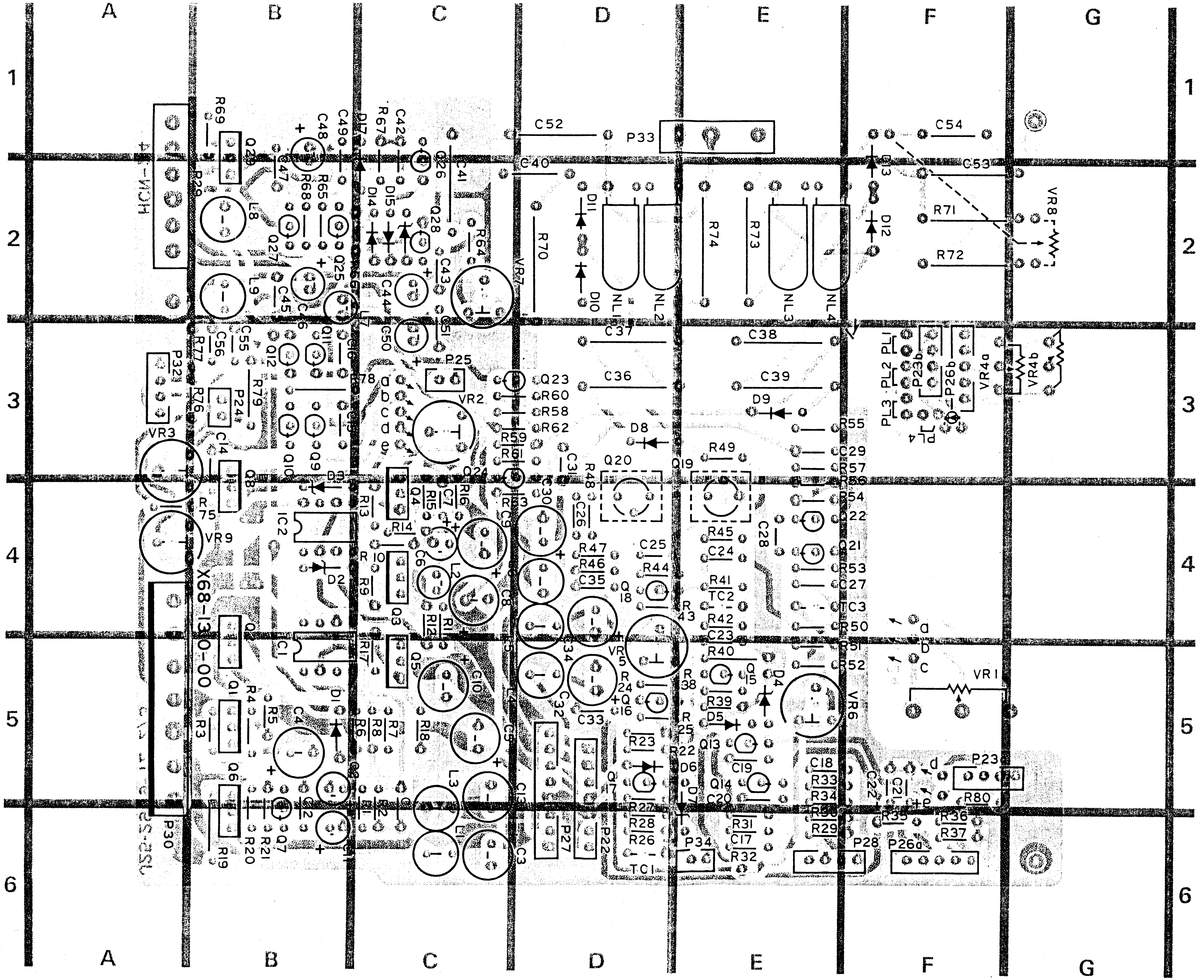
Q1,3,4 : 2SC1215T or S   D1 : WZ-081

Q2 : 2N5912 or U440

Q7 : 2SC2499

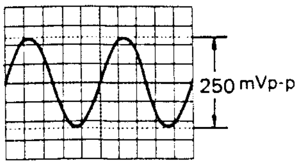
PC BOARD

X68-1310-00


A
B
C
D
E
F
G
1
2
3
4
5
6
X68-1310-00
VR1
VR2
VR3
VR6
VR7
VR8
VR9
VR4a
VR4b
NL1
NL2
NL3
NL4
P23
P25
P26a
P27
P28
P30
P32
P33
P34
IC1
IC2
TC1
TC2
TC3

WAVEFORMS

①③④



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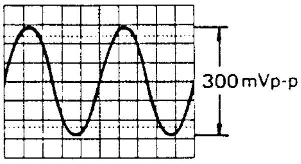

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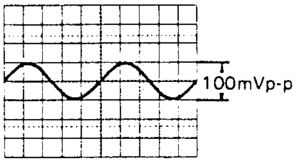

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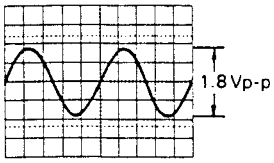

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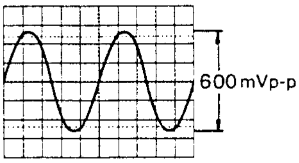
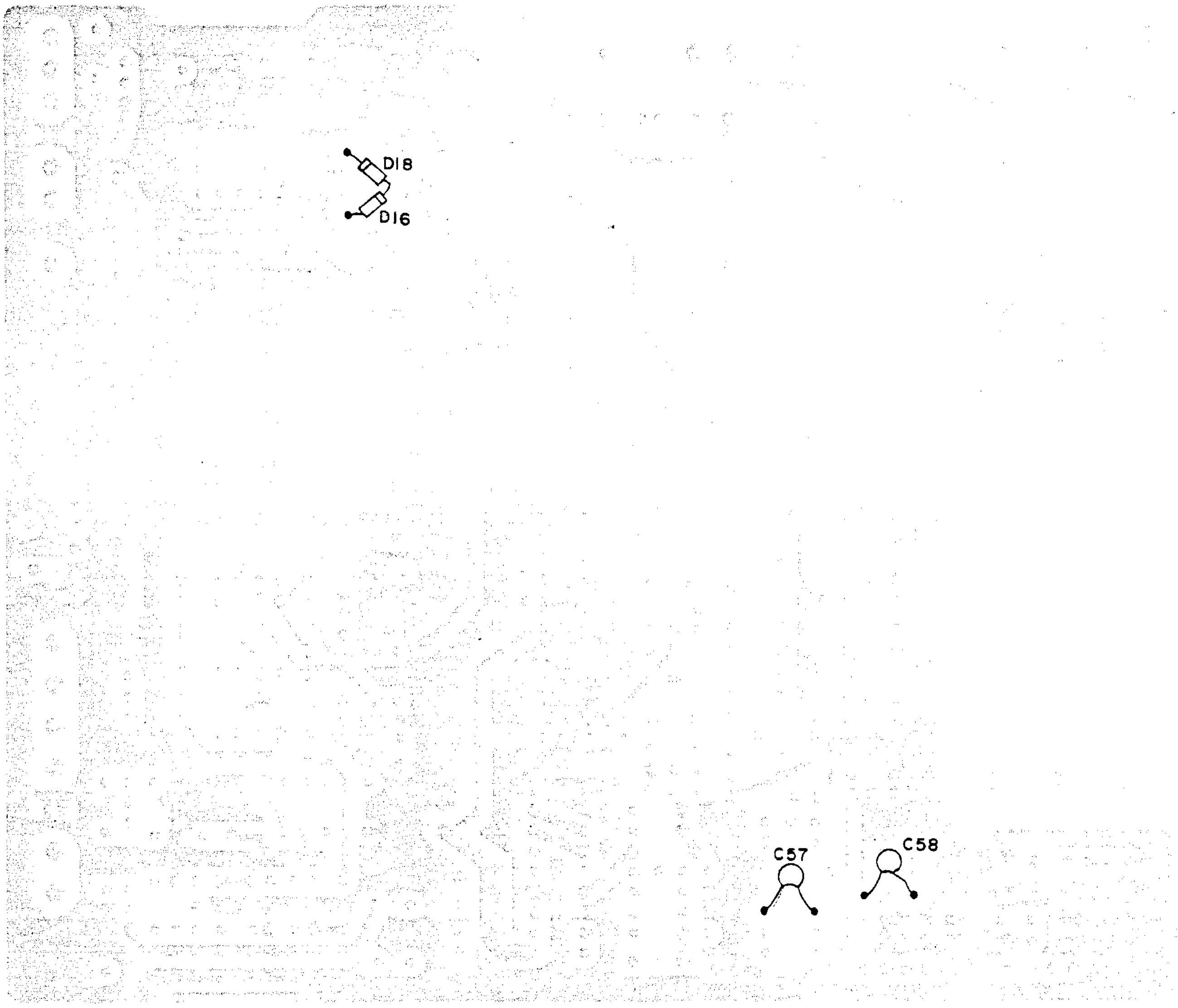
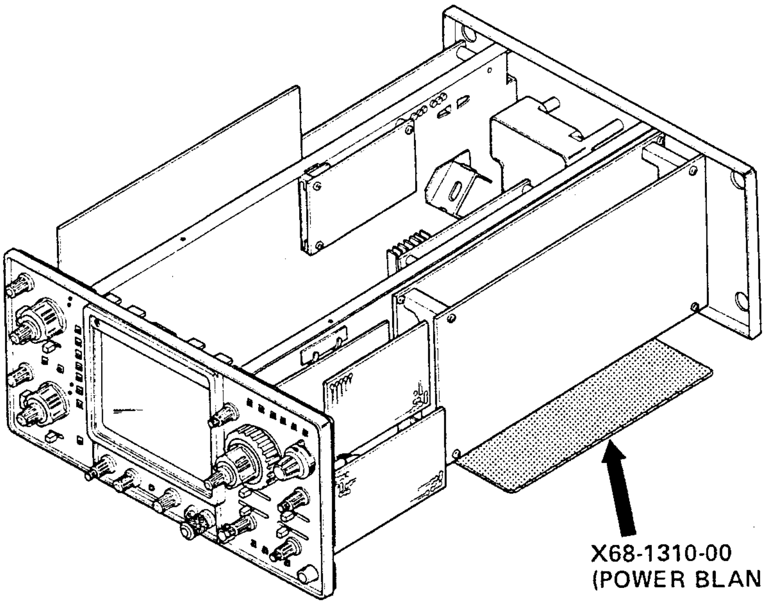


12-19

X68-1310-00

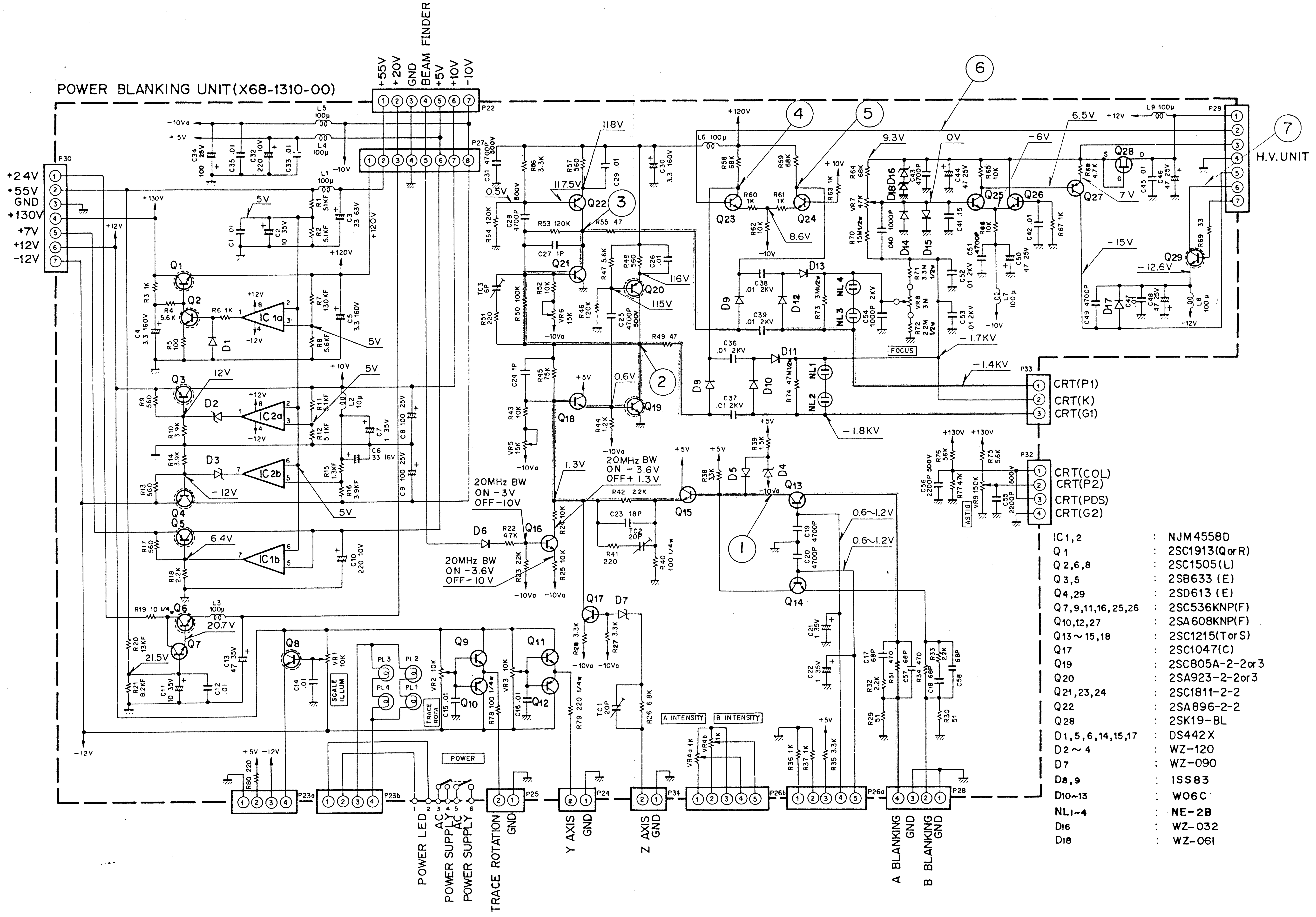

D18
D16
C57
C58

(Parts Side View)



X68-1310-00
(POWER BLANKING UNIT)

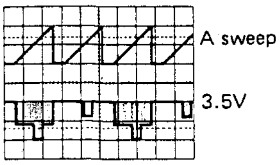
SCHEMATIC DIAGRAM


POWER BLANKING UNIT(X68-1310-00)
+55V
+20V
GND
BEAM FINDER
+5V
+10V
-10V
P22
P27
P30
+24V
+55V
GND
+130V
+7V
+12V
-12V
P29
H.V.UNIT
P33
CRT(P1)
CRT(K)
CRT(G1)
P32
CRT(COL)
CRT(P2)
CRT(PDS)
CRT(G2)
FOCUS
ASTIG
20MHz BW
ON -3V
OFF-10V
20MHz BW
ON -3.6V
OFF+ 1.3V
20MHz BW
ON -3.6V
OFF- 10 V
SCALE ILLUM
TRACE ROTA
A INTENSITY
B INTENSITY
POWER
P23a
P23b
P25
P24
P34
P26b
P26a
P28
POWER LED
AC POWER SUPPLY
AC POWER SUPPLY
TRACE ROTATION
GND
Y AXIS
GND
Z AXIS
GND
A BLANKING
GND
B BLANKING
GND
118V
117.5V
116V
115V
0.6V
1.3V
9.3V
0V
-6V
6.5V
8.6V
-15V
-12.6V
-1.7KV
-1.4KV
-1.8KV
12V
5V
-12V
6.4V
20.7V
21.5V
0.6~1.2V
7 V
①
②
③
④
⑤
⑥
⑦

IC1,2 : NJM4558D
Q 1 : 2SC1913(Q or R)
Q 2,6,8 : 2SC1505(L)
Q 3,5 : 2SB633 (E)
Q4,29 : 2SD613 (E)
Q7,9,11,16,25,26 : 2SC536KNP(F)
Q10,12,27 : 2SA608KNP(F)
Q13～15,18 : 2SC1215(T or S)
Q17 : 2SC1047(C)
Q19 : 2SC805A-2-2 or 3
Q20 : 2SA923-2-2 or 3
Q21,23,24 : 2SC1811-2-2
Q22 : 2SA896-2-2
Q28 : 2SK19-BL
D1,5,6,14,15,17 : DS442X
D2～4 : WZ-120
D7 : WZ-090
D8,9 : ISS83
D10～13 : W06C
NL1～4 : NE-2B
D16 : WZ-032
D18 : WZ-061

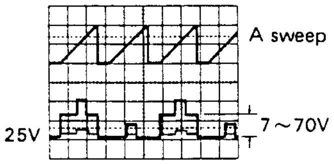
WAVEFORMS

①



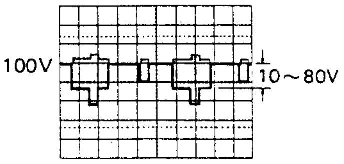
H.DISPLAY :ALT

②



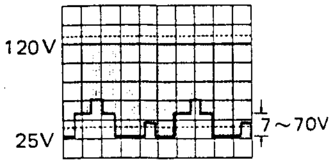
H.DISPLAY: ALT

③



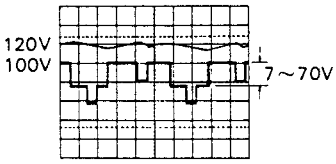
H.DISPLAY: ALT

④



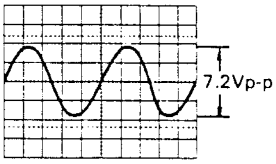
H.DISPLAY: ALT

⑤



H.DISPLAY: ALT

⑥



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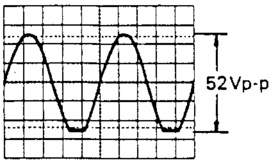

Note: ▨ : CHOP Operation

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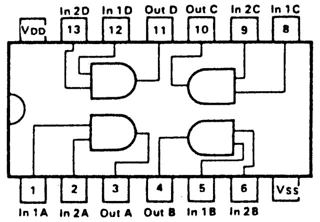
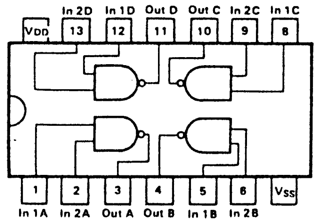
SEMICONDUCTORS CS-2100

C-MOS IC



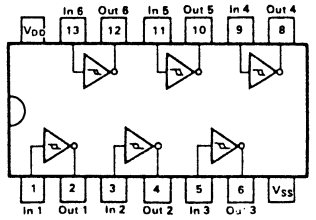
In 2D In 1D Out D Out C In 2C In 1C
VDD
VSS
In 1A In 2A Out A Out B In 1B In 2B

Top view
MC14081BCP



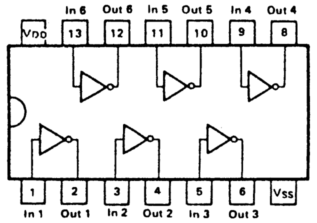
In 2D In 1D Out D Out C In 2C In 1C
VDD
VSS
In 1A In 2A Out A Out B In 1B In 2B

Top view
MC14011BCP



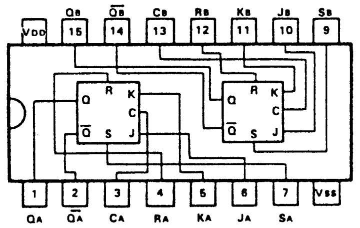
In 6 Out 6 In 5 Out 5 In 4 Out 4
VDD
VSS
In 1 Out 1 In 2 Out 2 In 3 Out 3

Top view
MC14584BCP



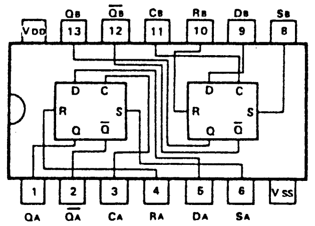
In 6 Out 6 In 5 Out 5 In 4 Out 4
VDD
VSS
In 1 Out 1 In 2 Out 2 In 3 Out 3

Top view
MC14069UBCP



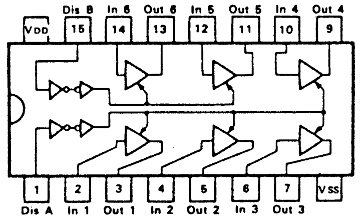
QB Q̄B CB RB KB JB SB
VDD
VSS
QA Q̄A CA RA KA JA SA

Top view
MC14027BCP



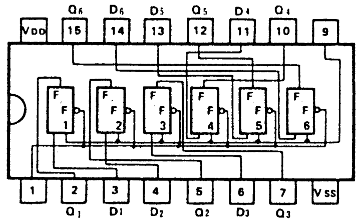
QB Q̄B CB RB DB SB
VDD
VSS
QA Q̄A CA RA DA SA

Top view
MC14013BCP



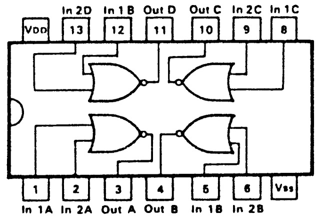
Dis B In 6 Out 6 In 5 Out 5 In 4 Out 4
VDD
VSS
Dis A In 1 Out 1 In 2 Out 2 In 3 Out 3

Top view
MC14503BCP



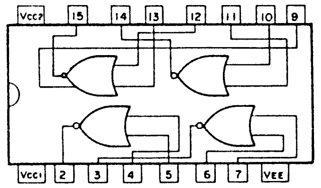
Q6 D6 D5 Q5 D4 Q4
VDD
VSS
Q1 D1 D2 Q2 D3 Q3

Top view
MC14174BCP



In 2D In 1B Out D Out C In 2C In 1C
VDD
VSS
In 1A In 2A Out A Out B In 1B In 2B

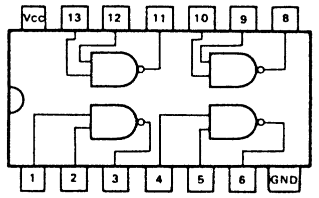
Top view
MC14001BCP



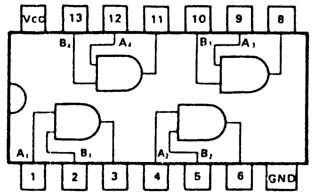
VCC2
VCC1
VEE

MC10102P

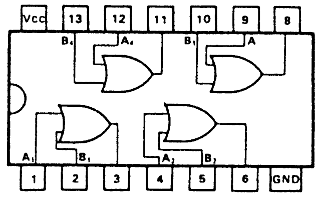
TTL IC



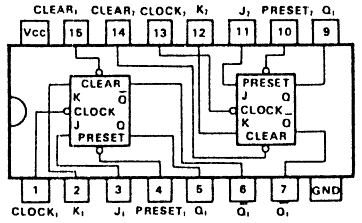
Top view
SN74S00N
SN74LS00N
74F00PC



Top view
SN74LS08N
SN74S08N

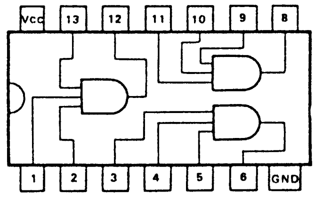


Top view
SN7432N
SN74LS32N
SN74S32N

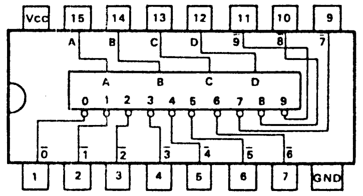


CLEAR2 CLEAR1 CLOCK2 K2 J2 PRESET2 Q2
Vcc
CLEAR
CLOCK
PRESET
GND
CLOCK1 K1 J1 PRESET1 Q1 Q̄1 Q2

Top view
SN74LS112AN
SN74S112N

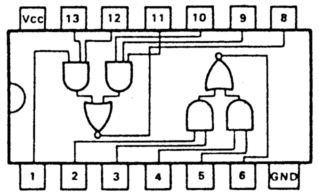


Top view
SN74LS11N

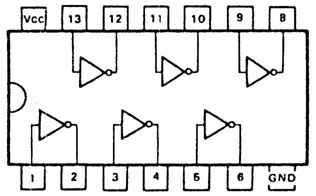


Vcc
A B C D
GND

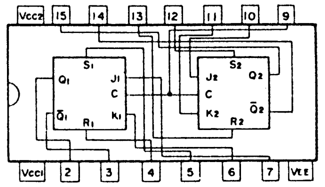
Top view
SN7442AN



Top view
SN74LS51N



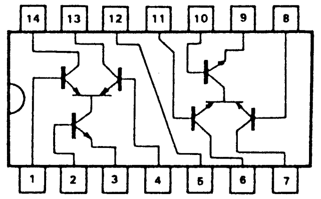
Top view
SN7404N
SN74LS04N



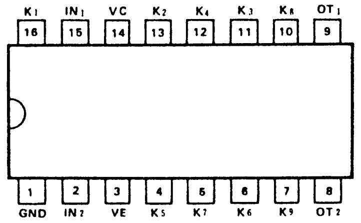
VCC2
VCC1
VEE

MC10135P

OTHER

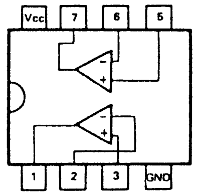


Top view
CA3102E

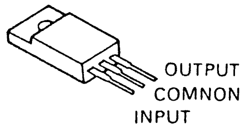


K1 IN1 VC K2 K4 K3 K8 OT1
GND IN2 VE K5 K7 K6 K9 OT2

Top view
ATM-4010



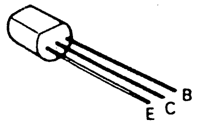
Top view
TL082CP
NJM4558D



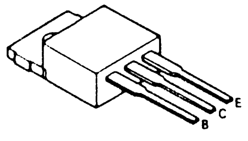
OUTPUT
COMNON
INPUT

FS7805L

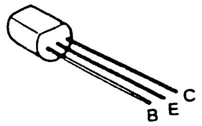
TRANSISTOR



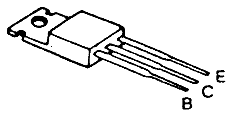
2SA608KNP (F)	2SC1047 (C)
2SA838 (C)	2SC1215 (T or S)
2SA896-2-2	2SC1811-2-2
2SD438 (F)	2SC1973 (T)
2SC536KNP (F)	



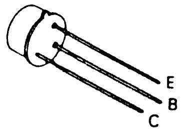
2SB633 (E)
2SD613 (E)
2SC1505 (L)



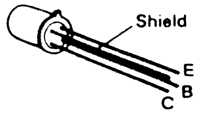
2SA1161
2SC2499
2SC2644



2SC1913 (Q, R)

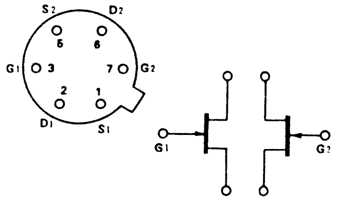


2SA923-2-2 or 3
2SC805A2-2 or 3



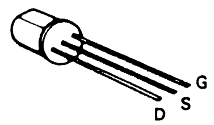
2SC1164 (O)

FET.

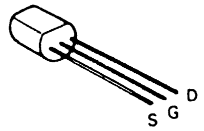


S2 D2
G1 G2
D1 S1
G1 G2

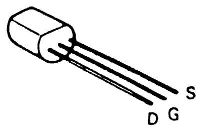
U440



2SK19 (BL)



2SK30A (O)
2SJ43 (O)



2SK127 (O)

CS-2100 SERVICE MANUAL CHANGE INFORMATION:

At Trio, we continually strive to keep up with latest electronic developements by adding circuit and component improvement to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these change immediately into printed manual.

Also, a single change may affect several section.
Since the change information sheets are permanently entered, some duplication may occur.

Because of the universal parts procurement problem, some electrical parts in your instrument may be different from those described in the replaceable electrical parts list. (Main chassis)

PARTS LIST

Note: A: Addition
C: Change
D: Deletion

S/NO. 2010001-

MAIN CHASSIS

Ref. No.	Parts No.	Name & Description	Note
	F10-1557-04	Earth band	A

S/NO. 2030001-

Ref. No.	Parts No.	Name & Description	Note
	W02-0402-25	High voltage block	C

VERTICAL ATT. UNIT (X75-1120-00)

Ref. No.	Parts No.	Name & Description		Note
VR1	R12-0539-05	VR	200Ω B	C
VR2	R12-0539-05	VR	200Ω B	C

VERTICAL PRE AMP UNIT (X73-1320-00)

Ref. No.	Parts No.	Name & Description				Note
R26	RD14BB2B470J	RD	47Ω	±5%	1/8W	A
R199	RD14BB2B470J	RD	47Ω	±5%	1/8W	A
R228	RD14BB2B471J	RD	470Ω	±5%	1/8W	A
R330	RD14BB2B100J	RD	10Ω	±5%	1/8W	A
R331	RD14BB2B100J	RD	10Ω	±5%	1/8W	A
R332	RD14BB2B100J	RD	10Ω	±5%	1/8W	A
C2	CC45CH1H220J	CC	22pF	±5%	50WV	C
C5	CC45CH1H050C	CC	5pF	±0.25pF	50WV	A
C6	CC45CH1H020C	CC	2pF	±0.25pF	50WV	D
C9	CC45CH1H120J	CC	12pF	±5%	50WV	C
C38	CC45CH1H330J	CC	33pF	±5%	50WV	C
C39	CC45CH1H330J	CC	33pF	±5%	50WV	C
C42	CC45CH1H050C	CC	5pF	±0.25pF	50WV	A
C43	CC45CH1H020C	CC	2pF	±0.25pF	50WV	D
C46	CC45CH1H120J	CC	12pF	±5%	50WV	C
C52	CC45CH1H120J	CC	12pF	±5%	50WV	A
C174	CC45CH1H020C	CC	2pF	±0.25pF	50WV	C
C185	CC45CH1H070D	CC	7pF	±0.5pF	50WV	A
C186	CC45CH1H070D	CC	7pF	±0.5pF	50WV	A
Q4		TR	2SA1161			C
Q5		TR	2SA1161			C
Q6		TR	2SA1161			C
Q7		TR	2SA1161			C
Q52		TR	2SA1161			C
Q53		TR	2SA1161			C
Q54		TR	2SA1161			C
Q55		TR	2SA1161			C

PARTS LIST

TRIG SWEEP UNIT (X74-1220-00)

Ref. No.	Parts No.	Name & Description	Note
VR1	R12-1517-05	VR 1kΩ B	C
VR2	R12-1517-05	VR 1kΩ B	C
VR3	R12-1517-05	VR 1kΩ B	C
VR5	R12-1517-05	VR 1kΩ B	C
VR7	R12-2512-05	VR 5kΩ B	C
VR8	R12-1518-05	VR 2kΩ B	C
VR9	R12-2512-05	VR 5kΩ B	C
VR10	R12-1518-05	VR 2kΩ B	C
VR11	R12-2512-05	VR 5kΩ B	C
VR12	R12-0421-05	VR 100Ω B	C
VR13	R12-0540-05	VR 500Ω B	C

HORIZONTAL MODE CONTROL UNIT (X77-1130-00)

Ref. No.	Parts No.	Name & Description	Note
VR1	R12-0542-05	VR 200Ω B	C
VR2	R12-5517-05	VR 100kΩ B	C
VR3	R12-0542-05	VR 200Ω B	C
VR4	R12-0542-05	VR 200Ω B	C
VR5	R12-0541-05	VR 100Ω B	A

A TRIG UNIT (X77-1110-00)

Ref. No.	Parts No.	Name & Description	Note
VR2	R12-3522-05	VR 10kΩ B	C
VR3	R12-0541-05	VR 100Ω B	C
VR4	R12-1519-05	VR 1kΩ B	C

B TRIG UNIT (X77-1120-00)

Ref. No.	Parts No.	Name & Description	Note
VR2	R12-3522-05	VR 10kΩ B	C
VR3	R12-0541-05	VR 100Ω B	C

S/NO. 2040001-

MAIN CHASSIS

Ref. No.	Parts No.	Name & Description	Note
	E31-2322-05	Leadwire with connector 1P	A
	A23-1627-12	Rear panel	C
	B07-0701-04	Push escutcheon	D
	D23-0801-04	Spacer	A
	G13-0714-04	Cushion	A

PARTS LIST

VERTICAL PRE AMP UNIT (X73-1320-00)

Ref. No.	Parts No.	Name & Description				Note
C182	CK45D1H103M	CK	0.01μF	±20%	50WV	A
C183	CC45CH1H101J	CC	100pF	±5%	50WV	A
VR3	R12-0421-05	VR	100Ω B			C
VR4	R12-0421-05	VR	100Ω B			C
VR5	R12-0421-05	VR	100Ω B			C
VR6	R12-0421-05	VR	100Ω B			C
VR7	R12-0539-05	VR	200Ω B			C
VR8	R12-0539-05	VR	200Ω B			C
VR9	R12-0540-05	VR	500Ω B			C
VR10	R12-0539-05	VR	200Ω B			C
VR11	R12-0421-05	VR	100Ω B			C
VR12	R12-0540-05	VR	500Ω B			C
VR13	R12-0421-05	VR	100Ω B			C
VR14	R12-0421-05	VR	100Ω B			C
VR15	R12-0421-05	VR	100Ω B			C
VR16	R12-0421-05	VR	100Ω B			C
VR17	R12-0421-05	VR	100Ω B			C
VR18	R12-0539-05	VR	200Ω B			C
VR19	R12-0539-05	VR	200Ω B			C
VR20	R12-0539-05	VR	200Ω B			C
VR21	R12-0421-05	VR	100Ω B			C
VR22	R12-0539-05	VR	200Ω B			C

VERTICAL OUTPUT UNIT (X73-1330-00)

Ref. No.	Parts No.	Name & Description				Note
R50	RD14BB2B101J	RD	100Ω	±5%	1/8W	A
VR1	R12-0541-05	VR	100Ω B			C

SWEEP ROTARY UNIT (X74-1250-00)

Ref. No.	Parts No.	Name & Description				Note
VR1	R12-1519-05	VR	1kΩ B			C

TRIG SWEEP UNIT (X74-1220-00)

Ref. No.	Parts No.	Name & Description				Note
R251	RD14BB2B392J	RD	3.9kΩ	±5%	1/8W	C
R268	RD14BB2B201J	RD	200Ω	±5%	1/8W	A
R269	RD14BB2B182J	RD	1.8kΩ	±5%	1/8W	A
R270	RD14BB2B470J	RD	47Ω	±5%	1/8W	A
C117	CC45SL1H681J	CC	680pF	±5%	50WV	C
C131	CC45SL1H221J	CC	220pF	±5%	50WV	A
D75		Diode	1N60			C
D107		Diode	DS442X			A

A TRIG UNIT (X77-1110-00)

Ref. No.	Parts No.	Name & Description				Note
R35	RN14BK2B1001F	RN	1kΩ	±1%	1/8W	C
D7		Diode	DS442X			A
D8		Diode	DS442X			A
D9		Diode	DS442X			A
D10		Diode	DS442X			A

PARTS LIST

POWER BLANKING UNIT (X68-1310-00)

Ref. No.	Parts No.	Name & Description				Note
R39	RD14BB2B122J	RD	1.2kΩ	±5%	1/8W	C
R82	RD14BB2B102J	RD	1kΩ	±5%	1/8W	A
VR5	R12-1028-05	VR	4.7kΩ B			C
C23	CC45CH1H220J	CC	22pF	±5%	50WV	C
C57	CC45CH1H101J	CC	100pF	±5%	50WV	C
C58	CC45CH1H101J	CC	100pF	±5%	50WV	C
	F02-0414-05	Heat sink				C

S/NO. 2060001-

VERTICAL ATT. UNIT (X75-1120-00)

Ref. No.	Parts No.	Name & Description		Note
Q1		TR	DN1901	C
Q2		TR	DN1901	C

VERTICAL OUTPUT UNIT (X73-1330-00)

Ref. No.	Parts No.	Name & Description		Note
Q13		TR	2SC2644	A
Q14		TR	2SC2644	A

HORIZONTAL MODE CONTROL UNIT (X77-1130-00)

Ref. No.	Parts No.	Name & Description				Note
R116	RD14BB2B472J	RD	4.7kΩ	±5%	1/8W	C
R117	RD14BB2B472J	RD	4.7kΩ	±5%	1/8W	C
R118	RD14BB2B472J	RD	4.7kΩ	±5%	1/8W	C
R119	RD14BB2B472J	RD	4.7kΩ	±5%	1/8W	C
Q13		TR	DN1901			C
Q17		TR	DN1901			C

A TRIG UNIT (X77-1110-00)

Ref. No.	Parts No.	Name & Description		Note
Q5		TR	DN1901	C

B TRIG UNIT (X77-1120-00)

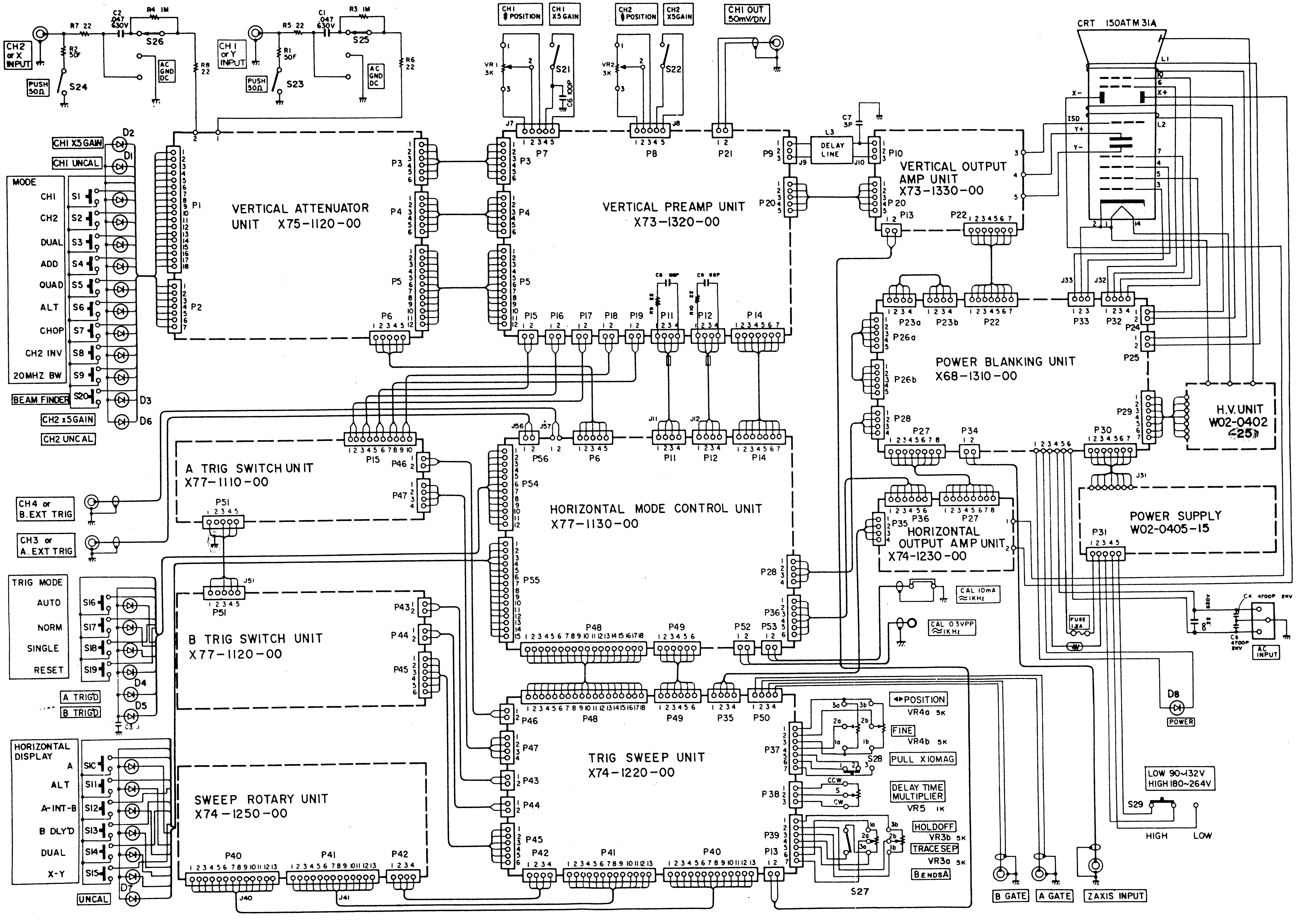
Ref. No.	Parts No.	Name & Description		Note
Q2		TR	DN1901	C

S/NO. 2070001-

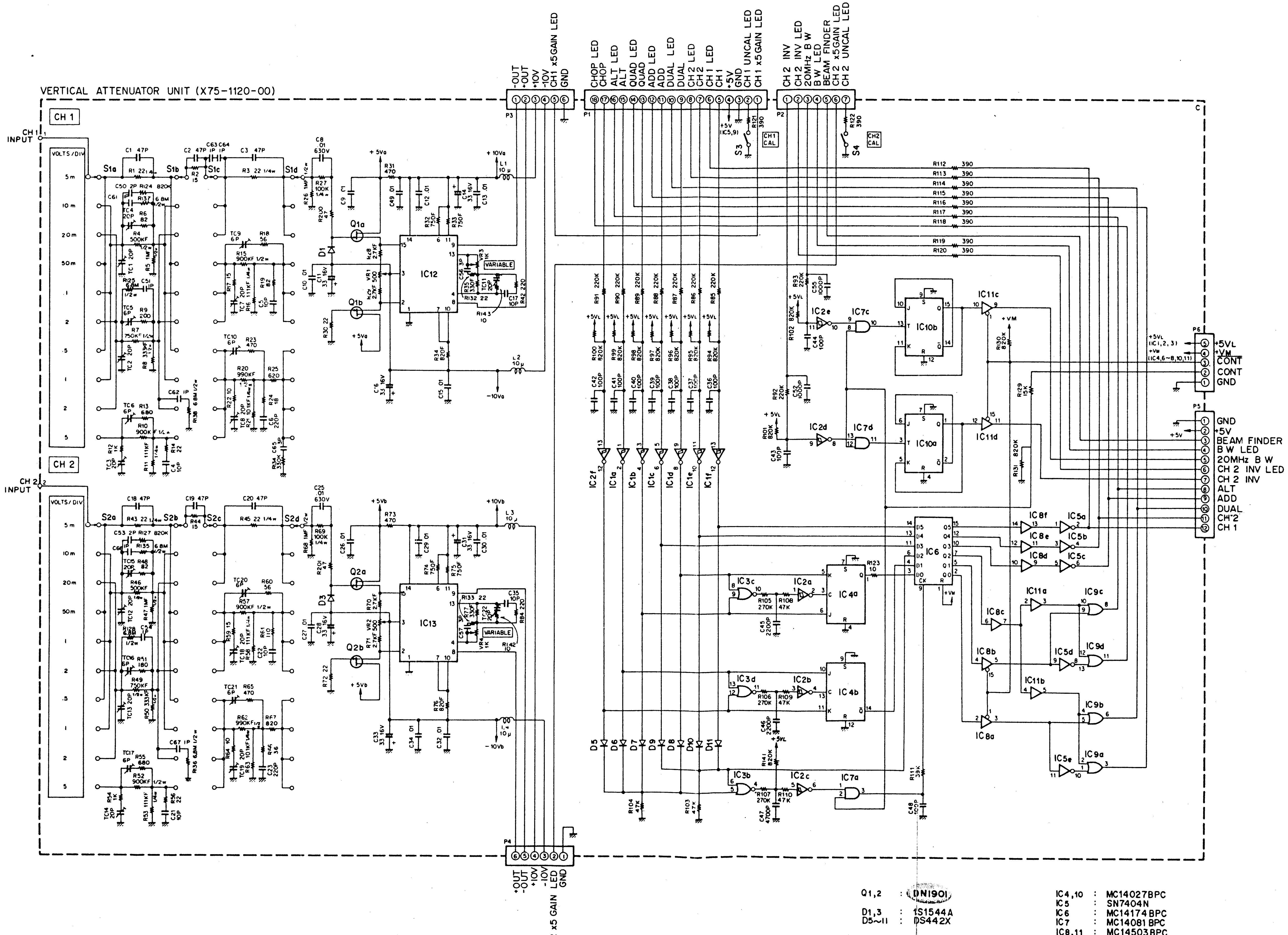
MAIN CHASSIS

Ref. No.	Parts No.	Name & Description	Note
	E23-0522-14	Earth plate	A
	J39-0509-04	Supporter for P.C.B.	A
	J42-0520-04	Edging	A

SCHEMATIC DIAGRAM


CH2 or X INPUT
R7 22
C2 .047 630V
R4 1M
S26
R2 50F
PUSH 50Ω
S24
AC GND DC
R8 22
CH1 or Y INPUT
R5 22
C1 .047 630V
R3 1M
S25
R1 50F
PUSH 50Ω
S23
AC GND DC
R6 22
CH1 ⇕POSITION
CH1 X5 GAIN
CH2 ⇕POSITION
CH2 X5GAIN
CH1 OUT 50mV/DIV
VR1 3K
S21
C6 100P
VR2 3K
S22
J7
P7
P8
J8
P21
C7 3P
L3
DELAY LINE
P9
J9
J10
P10
CRT 150ATM31A
L1
L2
X−
X+
ISD
Y+
Y−
CH1 X5 GAIN
CH1 UNCAL
D2
D1
MODE
CH1
CH2
DUAL
ADD
QUAD
ALT
CHOP
CH2 INV
20MHZ BW
BEAM FINDER
CH2 x5GAIN
CH2 UNCAL
S1
S2
S3
S4
S5
S6
S7
S8
S9
S20
D3
D6
P1
P2
VERTICAL ATTENUATOR UNIT X75-1120-00
P3
P4
P5
P6
VERTICAL PREAMP UNIT X73-1320-00
P20
VERTICAL OUTPUT AMP UNIT X73-1330-00
P13
P22
P15
P16
P17
P18
P19
P11
P12
P14
C8 68P
C9 68P
R9 22
R10 22
J33
J32
P23a
P23b
P22
P33
P32
P24
P25
P26a
P26b
POWER BLANKING UNIT X68-1310-00
H.V. UNIT W02-0402 -25
P29
P28
P27
P34
P30
J31
J11
J12
J56
J57
P56
P6
P11
P12
P14
A TRIG SWITCH UNIT X77-1110-00
P15
P46
P47
P51
P54
HORIZONTAL MODE CONTROL UNIT X77-1130-00
P36
P27
P35
HORIZONTAL OUTPUT AMP UNIT X74-1230-00
POWER SUPPLY W02-0405-15
P31
CH4 or B.EXT TRIG
CH3 or A.EXT TRIG
J51
P51
P55
P28
P36
TRIG MODE
AUTO
NORM
SINGLE
RESET
S16
S17
S18
S19
B TRIG SWITCH UNIT X77-1120-00
P43
P44
P45
P48
P49
P52
P53
CAL 10mA ≈1KHz
CAL 0.3VPP ≈1KHz
FUSE 1.2A
C4 4700P 2KV
C5 4700P 2KV
630V
AC INPUT
A TRIG'D
B TRIG'D
D4
D5
C3
P46
P48
P49
P35
P50
◂▸POSITION
VR4a 5K
FINE
VR4b 5K
PULL X10MAG
S28
P37
D8
POWER
HORIZONTAL DISPLAY
A
ALT
A-INT-B
B DLY'D
DUAL
X-Y
UNCAL
S10
S11
S12
S13
S14
S15
D7
P47
P43
P44
P45
P42
TRIG SWEEP UNIT X74-1220-00
P38
DELAY TIME MULTIPLIER
VR5 1K
CCW
CW
LOW 90~132V
HIGH 180~264V
S29
HIGH
LOW
SWEEP ROTARY UNIT X74-1250-00
P40
P41
P42
J40
J41
P39
P13
HOLDOFF
VR3b 5K
TRACE SEP
VR3a 5K
BENDS A
S27
B GATE
A GATE
Z AXIS INPUT

SCHEMATIC DIAGRAM


VERTICAL ATTENUATOR UNIT (X75-1120-00)
CH 1
CH 1 INPUT
CH 2
CH 2 INPUT
VOLTS/DIV
5m
10m
20m
50m
.1
.2
.5
1
2
5
S1a
S1b
S1c
S1d
S2a
S2b
S2c
S2d
IC12
IC13
VARIABLE
Q1a
Q1b
Q2a
Q2b
D1
D3
D5
D6
D7
D8
D9
D10
D11
P1
P2
P3
P4
P5
P6
-OUT
+OUT
+10V
-10V
CH1 x5 GAIN LED
GND
CHOP LED
CHOP
ALT LED
ALT
QUAD LED
QUAD
ADD LED
ADD
DUAL LED
DUAL
CH 2 LED
CH 2
CH 1 LED
CH 1
+5V
CH 1 UNCAL LED
CH 2 INV
CH 2 INV LED
20MHz B W
B W LED
BEAM FINDER
CH 2 x5GAIN LED
CH 2 UNCAL LED
S3
S4
CH1 CAL
CH2 CAL
+5VL
+VM
CONT
BEAM FINDER
B W LED
20MHz B W
CH 2 INV LED
CH 2 INV
IC2a
IC2b
IC2c
IC2d
IC2e
IC3b
IC3c
IC3d
IC4a
IC4b
IC5a
IC5b
IC5c
IC5d
IC5e
IC6
IC7a
IC7c
IC7d
IC8a
IC8b
IC8c
IC8d
IC8e
IC8f
IC9a
IC9b
IC9c
IC9d
IC10a
IC10b
IC11a
IC11b
IC11c
IC11d
IC1a
IC1b
IC1c
IC1d
IC1e
IC1f
IC2f
+5Va
+10Va
-10Va
+5Vb
+10Vb
-10Vb
x5 GAIN LED

Q1,2 : DN1901

D1,3 : 1S1544A
D5~11 : DS442X

IC4,10 : MC14027BPC
IC5 : SN7404N
IC6 : MC14174BPC
IC7 : MC14081BPC
IC8,11 : MC14503BPC

PARTS LIST

VERTICAL ATT. UNIT (X75-1120-00)

Ref. No.	Parts No.	Name & Description				Note
R103	RD14BB2B473J	RD	47 kΩ	±5%	1/8W	C
R104	RD14BB2B473J	RD	47 kΩ	±5%	1/8W	C

VERTICAL PRE AMP UNIT (X73-1320-00)

Ref. No.	Parts No.	Name & Description				Note
R40	RN14BK2B1800F	RN	180Ω	±1%	1/8W	C
R110	RN14BK2B1001F	RN	1kΩ	±1%	1/8W	C
R118	RN14BK2B2200F	RN	220Ω	±1%	1/8W	C
R213	RN14BK2B1800F	RN	180Ω	±1%	1/8W	C
R272	RN14BK2B1001F	RN	1kΩ	±1%	1/8W	C
R280	RN14BK2B2200F	RN	220Ω	±1%	1/8W	C
R311	RD14BB2B100J	RD	10Ω	±5%	1/8W	A
R333	RD14BB2B470J	RD	47Ω	±5%	1/8W	A
R334	RD14BB2B470J	RD	47Ω	±5%	1/8W	A
C155	CC45CH1H100D	CC	10pF	±0.5pF	50WV	A

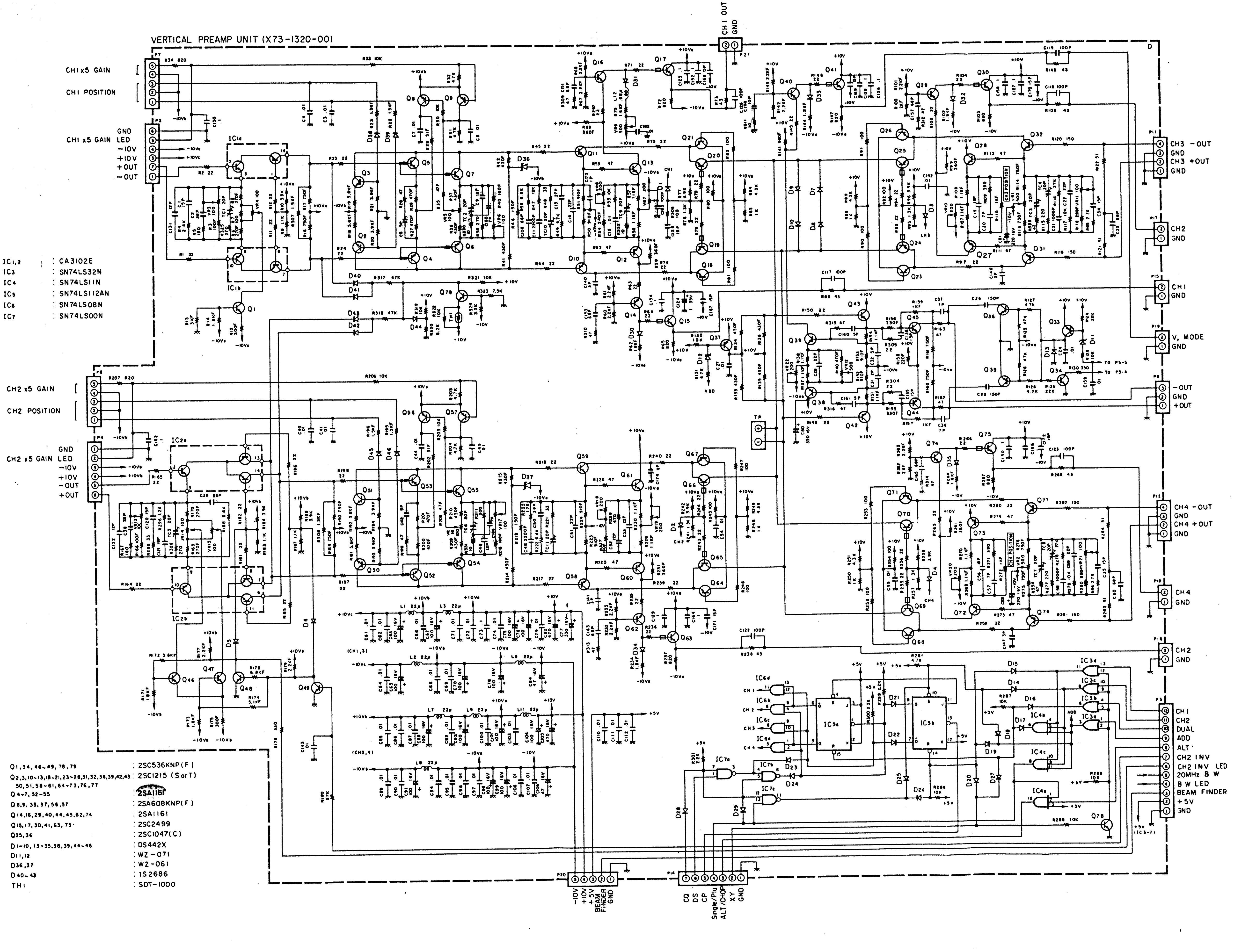
HORIZONTAL OUTPUT UNIT (X74-1230-00)

Ref. No.	Parts No.	Name & Description				Note
R6	RD14BB2H473J	RD	47kΩ	±5%	1/2W	C
R7	RD14BB2H473J	RD	47kΩ	±5%	1/2W	C

HORIZONTAL MODE CONTROL UNIT (X77-1130-00)

Ref. No.	Parts No.	Name & Description				Note
R116	RD14BB2B472J	RD	4.7kΩ	±5%	1/8W	D

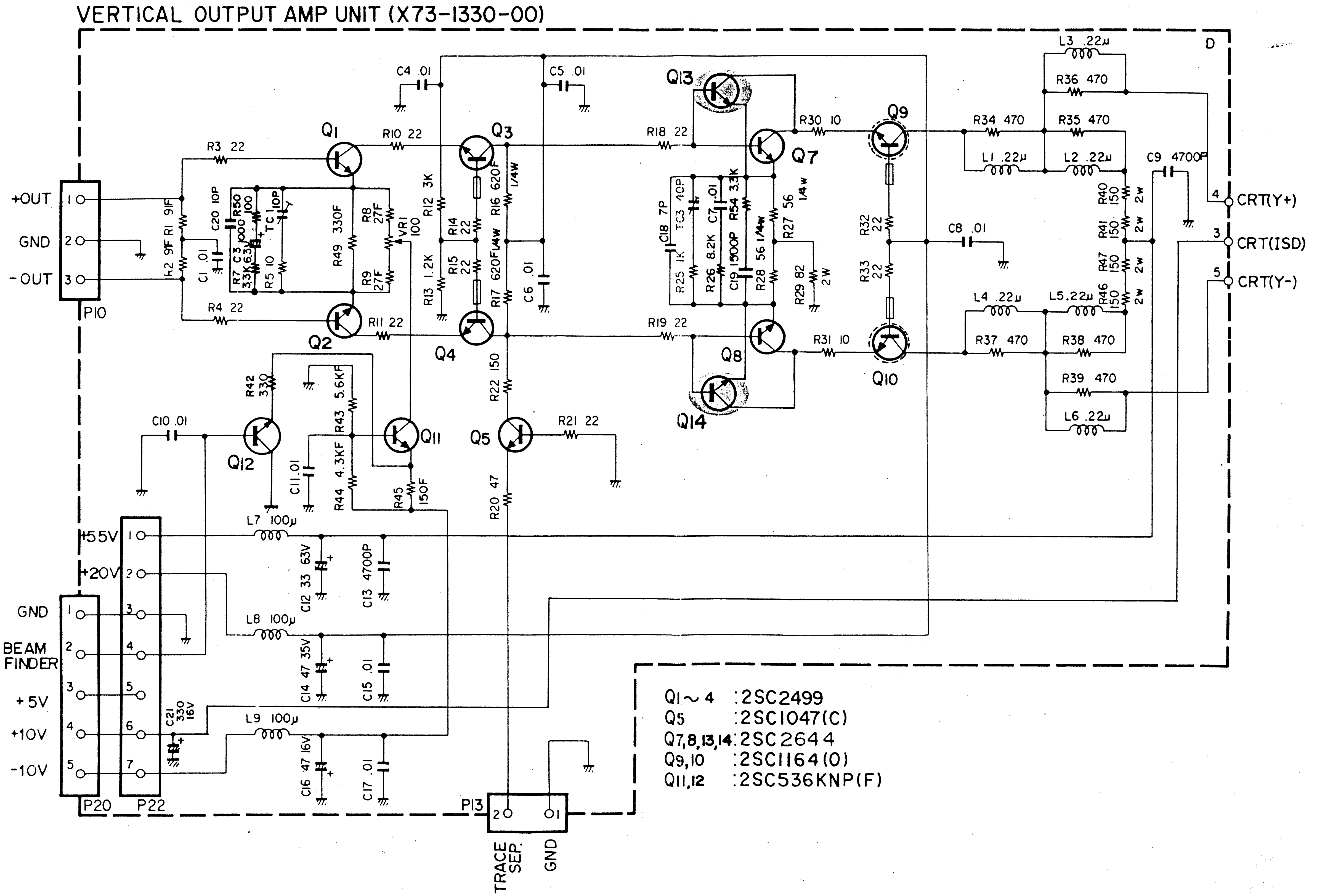
SCHEMATIC DIAGRAM


VERTICAL PREAMP UNIT (X73-1320-00)
CH1 OUT
GND
CH1x5 GAIN
CH1 POSITION
GND
CH1 x5 GAIN LED
-10V
+10V
+OUT
-OUT
IC1a
IC1b
CH2 x5 GAIN
CH2 POSITION
GND
CH2 x5 GAIN LED
-10V
+10V
-OUT
+OUT
IC2a
IC2b
CH3 -OUT
GND
CH3 +OUT
GND
CH2
GND
CH1
GND
V, MODE
GND
-OUT
GND
+OUT
TP
CH4 -OUT
GND
CH4 +OUT
GND
CH4
GND
CH2
GND
CH3 POSITION
CH4 POSITION
CH1
CH2
DUAL
ADD
ALT
CH2 INV
CH2 INV LED
20MHz B W
B W LED
BEAM FINDER
+5V
GND
IC3a
IC3b
IC3c
IC3d
IC4a
IC4b
IC4c
IC5a
IC5b
IC6a
IC6b
IC6c
IC6d
IC7a
IC7b
IC7c
-10V
+10V
+5V
BEAM FINDER
GND
CQ
DS
CP
Single/Plu
ALT/CHOP
XY
GND

IC1,2	:	CA3102E
IC3	:	SN74LS32N
IC4	:	SN74LS11N
IC5	:	SN74LS112AN
IC6	:	SN74LS08N
IC7	:	SN74LS00N

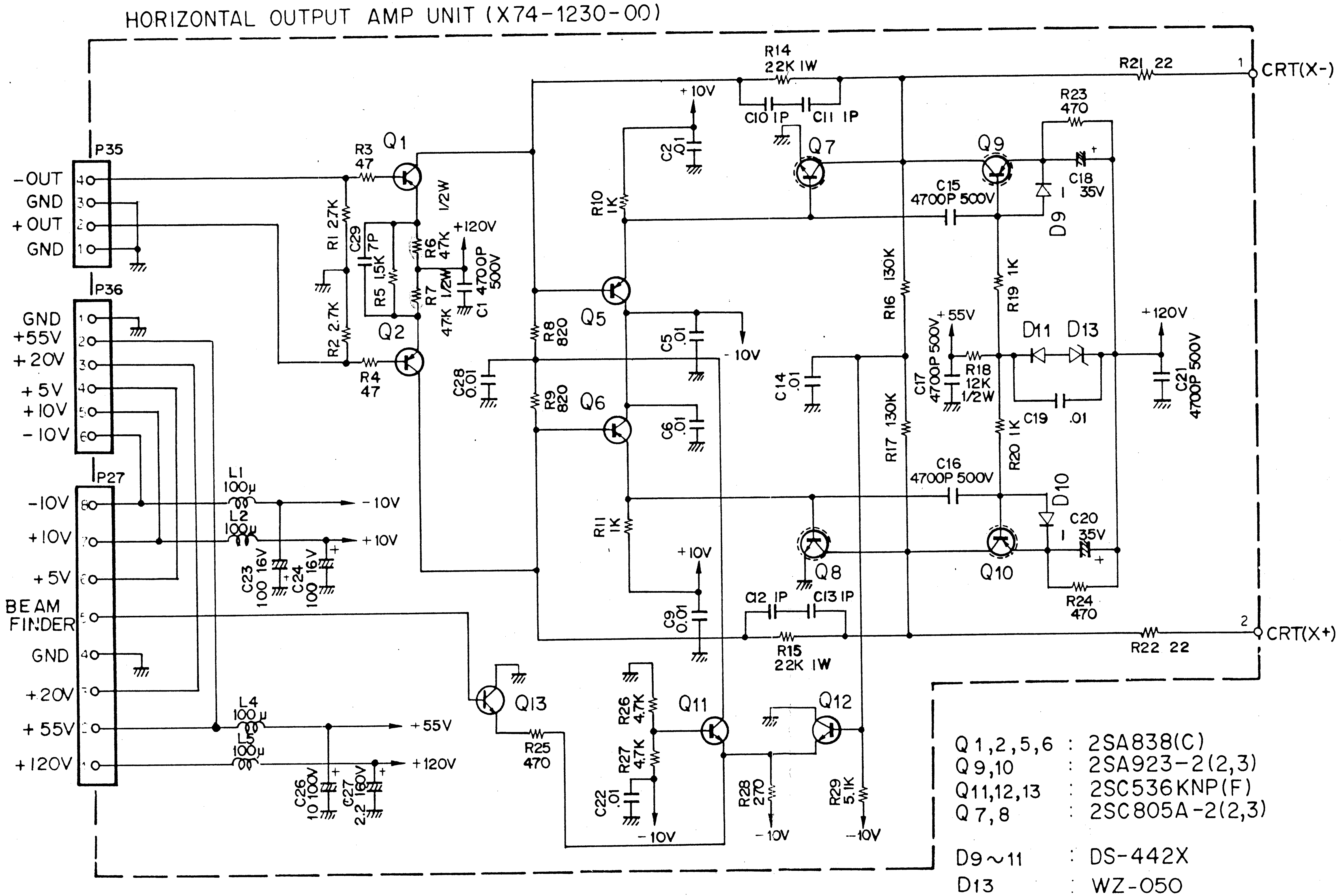
Q1,34,46~49,78,79	:	2SC536KNP(F)
Q2,3,10~13,18~21,23~28,31,32,38,39,42,43 50,51,58~61,64~73,76,77	:	2SC1215 (S or T)
Q4~7,52~55	:	2SA1161
Q8,9,33,37,56,57	:	2SA608KNP(F)
Q14,16,29,40,44,45,62,74	:	2SA1161
Q15,17,30,41,63,75	:	2SC2499
Q35,36	:	2SC1047(C)
D1~10,13~35,38,39,44~46	:	DS442X
D11,12	:	WZ-071
D36,37	:	WZ-061
D40~43	:	1S2686
TH1	:	SDT-1000

SCHEMATIC DIAGRAM


VERTICAL OUTPUT AMP UNIT (X73-1330-00)
D
+OUT
GND
-OUT
P10
R1 91F
R2 91F
R3 22
R4 22
C20 10P
R50 100
C3 1000 6.3V
R7 3.3K
R5 10
TC1 10P
C1 .01
R49 330F
R8 27F
R9 27F
VR1 100
Q1
Q2
R10 22
R11 22
C4 .01
C5 .01
Q3
Q4
R12 3K
R13 1.2K
R14 22
R15 22
R16 620F 1/4W
R17 620F 1/4W
C6 .01
R22 150
Q5
R21 22
R20 47
R18 22
R19 22
Q13
Q14
Q7
Q8
C18 7P
TC3 10P
C7 .01
R54 3.3K
R25 1K
R26 8.2K
C19 1500P
R28 56 1/4W
R27 56 1/4W
R29 82 2W
R30 10
R31 10
Q9
Q10
R32 22
R33 22
C8 .01
R34 470
R35 470
R36 470
R37 470
R38 470
R39 470
L1 .22μ
L2 .22μ
L3 .22μ
L4 .22μ
L5 .22μ
L6 .22μ
R40 150 2W
R41 150 2W
R47 150 2W
R46 150 2W
C9 4700P
CRT(Y+)
CRT(ISD)
CRT(Y-)
4
3
5
R42 330
C10 .01
Q12
R43 5.6KF
R44 4.3KF
C11 .01
Q11
R45 150F
+55V
+20V
GND
BEAM FINDER
+5V
+10V
-10V
P20
P22
L7 100μ
C12 33 63V
C13 4700P
L8 100μ
C14 47 35V
C15 .01
C21 330 16V
L9 100μ
C16 47 16V
C17 .01
P13
TRACE SEP.
GND
1
2
3
4
5
6
7

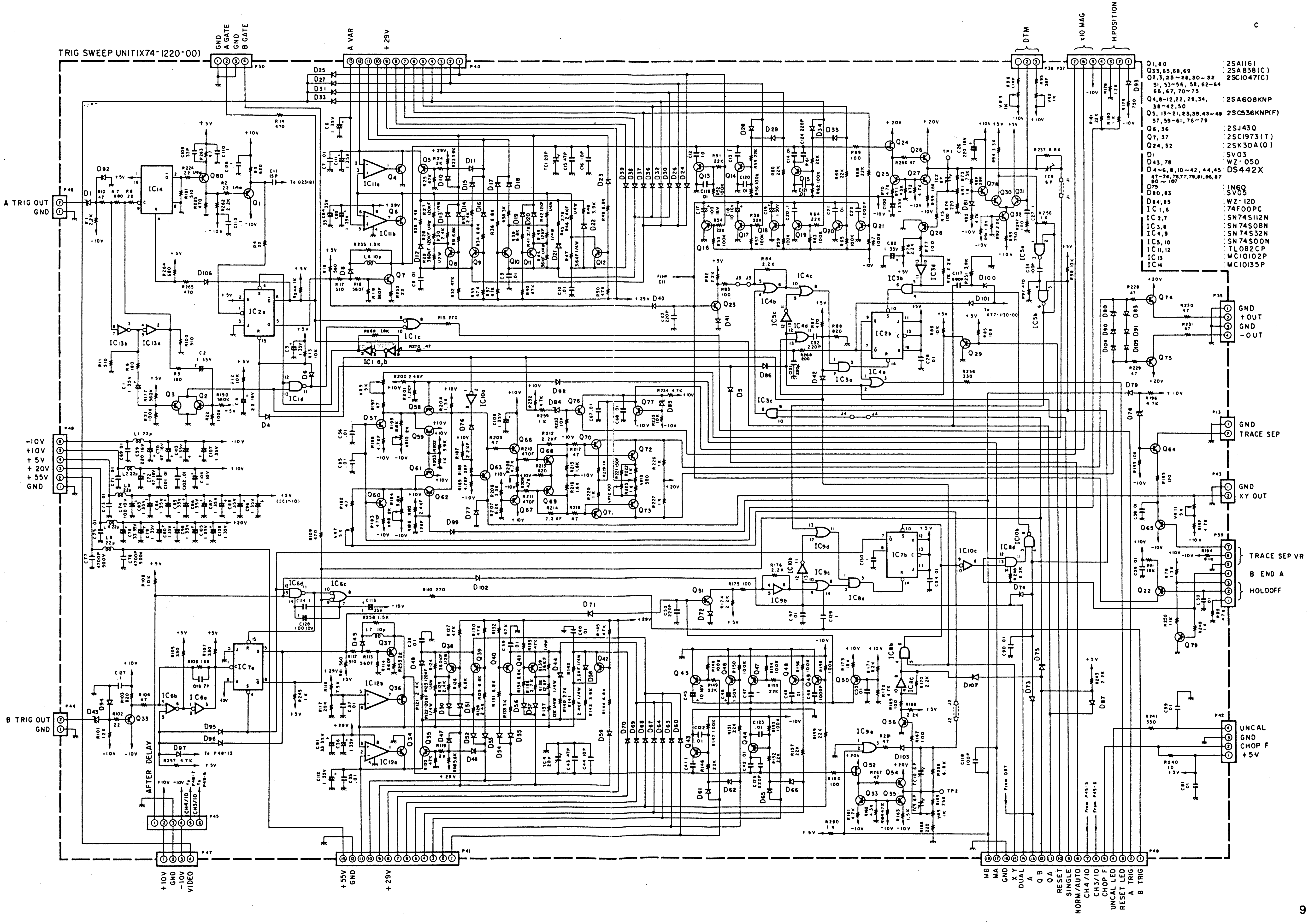
Q1～4 :2SC2499
Q5 :2SC1047(C)
Q7,8,13,14:2SC2644
Q9,10 :2SC1164(O)
Q11,12 :2SC536KNP(F)

SCHEMATIC DIAGRAM


HORIZONTAL OUTPUT AMP UNIT (X74-1230-00)
P35
-OUT
GND
+OUT
GND
P36
GND
+55V
+20V
+5V
+10V
-10V
P27
-10V
+10V
+5V
BEAM FINDER
GND
+20V
+55V
+120V
L1 100µ
L2 100µ
L4 100µ
L5 100µ
C23 100 16V
C24 100 16V
C26 10 100V
C27 2.2 160V
Q1
Q2
R3 47
R4 47
R1 2.7K
R2 2.7K
C29 7P
R5 1.5K
R6 47K 1/2W
R7 47K 1/2W
C1 4700P 500V
+120V
R8 820
R9 820
C28 0.01
Q5
Q6
R10 1K
R11 1K
C2 .01
C5 .01
C6 .01
C9 0.01
+10V
-10V
R14 22K 1W
C10 1P
C11 1P
Q7
Q8
C12 1P
C13 1P
R15 22K 1W
C14 .01
R16 130K
R17 130K
C15 4700P 500V
C16 4700P 500V
C17 4700P 500V
+55V
R18 12K 1/2W
R19 1K
R20 1K
Q9
Q10
D9
D10
D11
D13
C18 1 35V
C20 1 35V
C19 .01
R23 470
R24 470
+120V
C21 4700P 500V
R21 22
R22 22
CRT(X-)
CRT(X+)
Q13
R25 470
Q11
Q12
R26 4.7K
R27 4.7K
C22 .01
R28 270
R29 5.1K
-10V

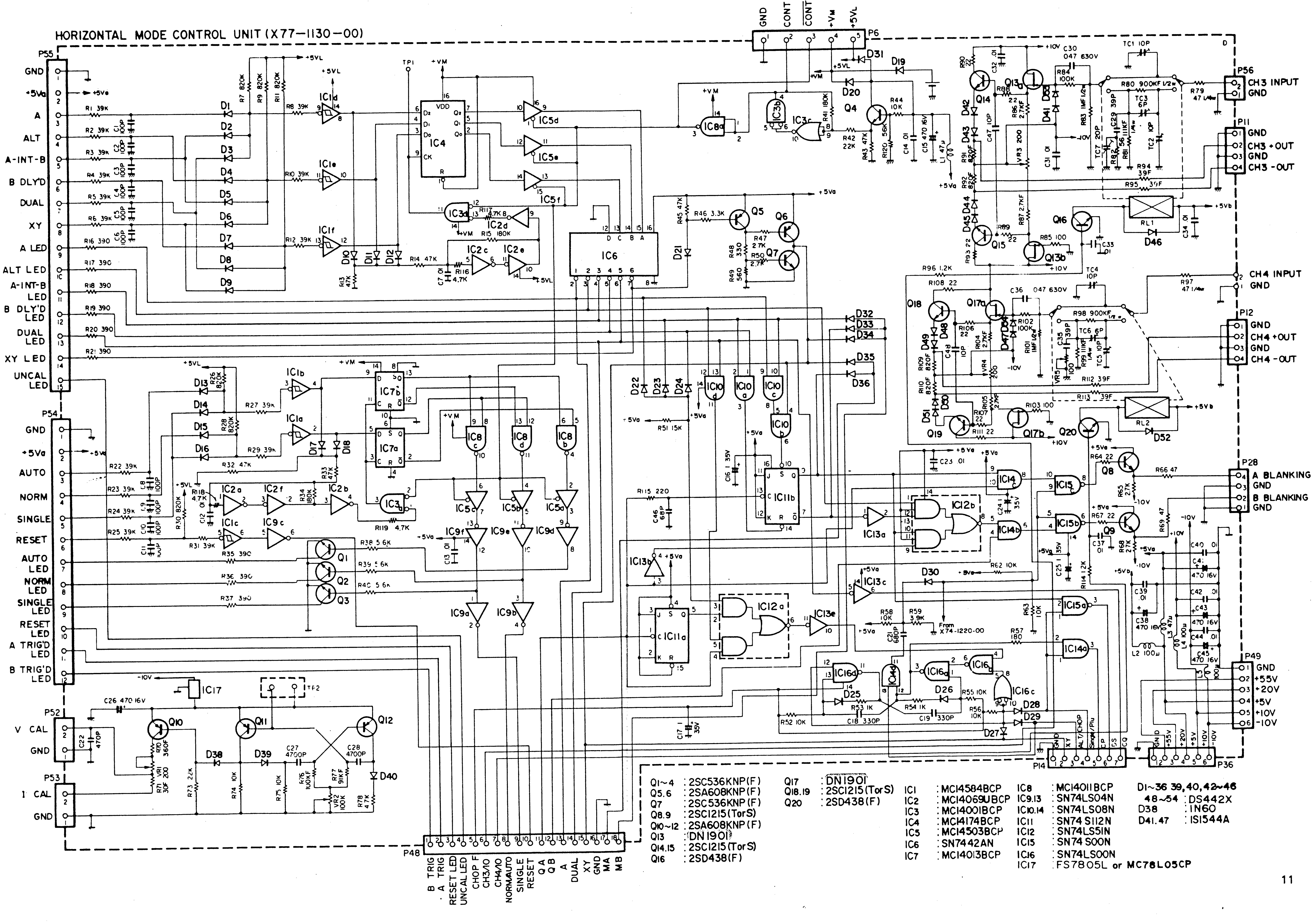
Q1,2,5,6 : 2SA838(C)
Q9,10 : 2SA923-2(2,3)
Q11,12,13 : 2SC536KNP(F)
Q7,8 : 2SC805A-2(2,3)
D9~11 : DS-442X
D13 : WZ-050

SCHEMATIC DIAGRAM


TRIG SWEEP UNIT (X74-1220-00)
P50
GND
A GATE
GND
B GATE
A VAR
+29V
P40
DTM
×10 MAG
H.POSITION
P46
A TRIG OUT
GND
P49
-10V
+10V
+5V
+20V
+55V
GND
P44
B TRIG OUT
GND
AFTER DELAY
P45
+10V
-10V
CH4/10
CH3/10
P47
+10V
GND
-10V
VIDEO
P41
+55V
GND
+29V
P35
GND
+OUT
GND
-OUT
P13
GND
TRACE SEP
P43
GND
XY OUT
P39
TRACE SEP VR
B END A
HOLDOFF
P42
UNCAL
GND
CHOP F
+5V
P48
MB
MA
GND
X Y
DUAL
A
O B
O A
RESET
SINGLE
NORM/AUTO
CH4/10
CH3/10
CHOP F
UNCAL LED
RESET LED
A TRIG
B TRIG

Q1, 80	2SA1161
Q33, 65, 68, 69	2SA838(C)
Q2, 3, 25～28, 30～32 51, 53～56, 58, 62～64 66, 67, 70～75	2SC1047(C)
Q4, 8～12, 22, 29, 34, 38～42, 50	2SA608KNP
Q5, 13～21, 23, 35, 43～49 57, 59～61, 76～79	2SC536KNP(F)
Q6, 36	2SJ43Q
Q7, 37	2SC1973(T)
Q24, 52	2SK30A(O)
D1	SV03
D43, 78	WZ-050
D4～6, 8, 10～42, 44, 45 47～74, 76, 77, 79, 81, 86, 87 90～107	DS442X
D75	1N60
D80, 83	SV05
D84, 85	WZ-120
IC1, 6	74F00PC
IC2, 7	SN74S112N
IC3, 8	SN74S08N
IC4, 9	SN74S32N
IC5, 10	SN74S00N
IC11, 12	TL082CP
IC13	MC10102P
IC14	MC10135P

SCHEMATIC DIAGRAM


HORIZONTAL MODE CONTROL UNIT (X77-1130-00)
P55
GND
+5Va
A
ALT
A-INT-B
B DLY'D
DUAL
XY
A LED
ALT LED
A-INT-B LED
B DLY'D LED
DUAL LED
XY LED
UNCAL LED
P54
GND
+5Va
AUTO
NORM
SINGLE
RESET
AUTO LED
NORM LED
SINGLE LED
RESET LED
A TRIG'D LED
B TRIG'D LED
P52
V CAL
GND
P53
I CAL
GND
P6
GND
CONT
CONT
+VM
+5VL
P56
CH3 INPUT
GND
P11
GND
CH3 +OUT
GND
CH3 -OUT
CH4 INPUT
GND
P12
GND
CH4 +OUT
GND
CH4 -OUT
P28
A BLANKING
GND
B BLANKING
GND
P49
GND
+55V
+20V
+5V
+10V
-10V
P14
GND
XY
ALT/CHOP
Single/Plu
CP
GS
CQ
P36
GND
+55V
+20V
+5V
+10V
-10V
P48
B TRIG
A TRIG
RESET LED
UNCAL LED
CHOP F
CH3/10
CH4/10
NORMAUTO
SINGLE
RESET
QA
QB
A
DUAL
XY
GND
MA
MB
IC1
IC2
IC3
IC4
IC5
IC6
IC7
IC8
IC9
IC10
IC11
IC12
IC13
IC14
IC15
IC16
IC17
RL1
RL2
TP1
TP2
From X74-1220-00

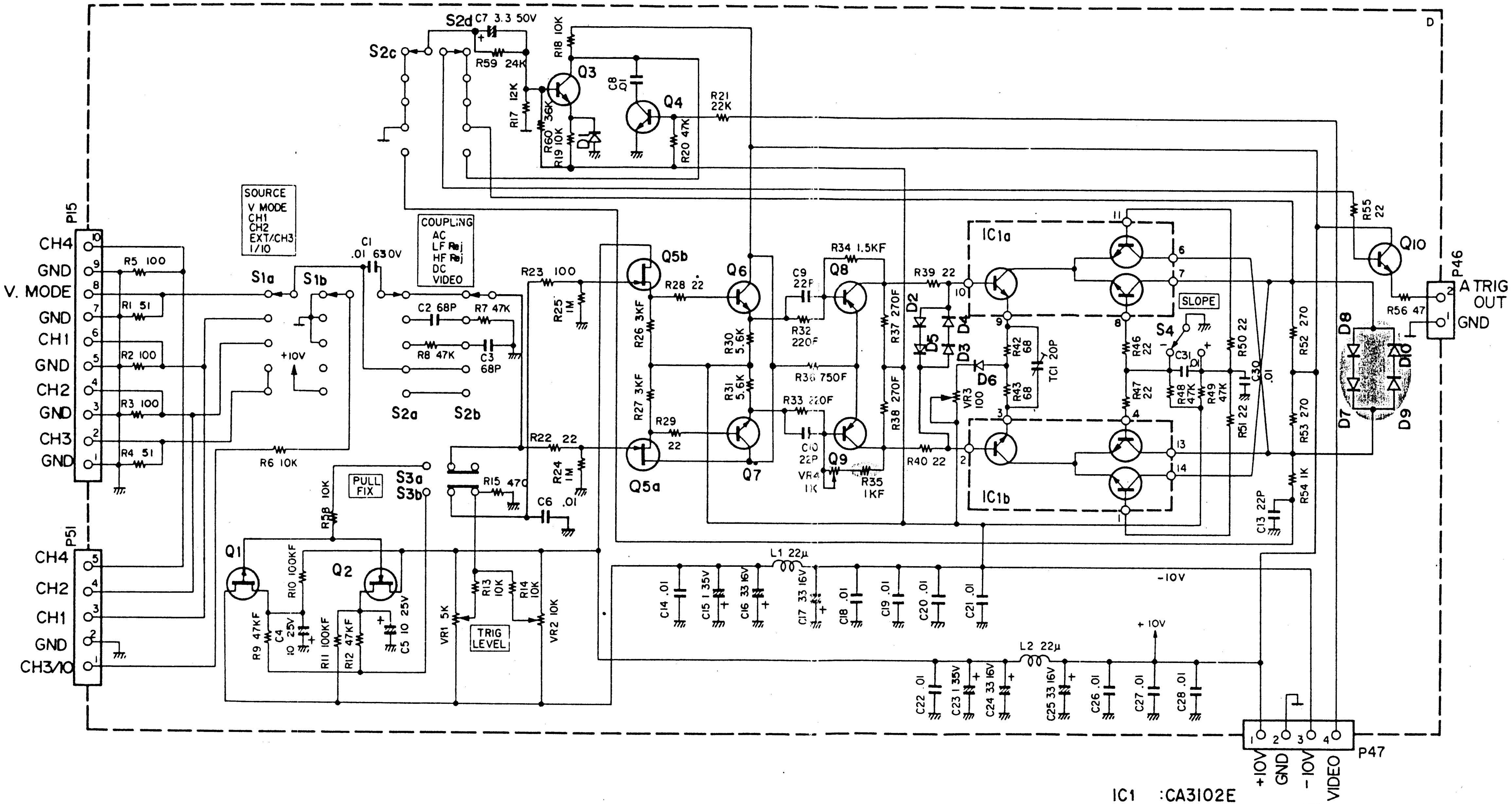
Q1~4	: 2SC536KNP(F)	Q17	: DN1901	IC1	: MC14584BCP
Q5.6	: 2SA608KNP(F)	Q18.19	: 2SC1215(TorS)	IC2	: MC14069UBCP
Q7	: 2SC536KNP(F)	Q20	: 2SD438(F)	IC3	: MC14001BCP
Q8.9	: 2SC1215(TorS)			IC4	: MC14174BCP
Q10~12	: 2SA608KNP(F)			IC5	: MC14503BCP
Q13	: DN1901			IC6	: SN7442AN
Q14.15	: 2SC1215(TorS)			IC7	: MC14013BCP
Q16	: 2SD438(F)				

IC8	: MC14011BCP
IC9.13	: SN74LS04N
IC10.14	: SN74LS08N
IC11	: SN74 S112N
IC12	: SN74LS51N
IC15	: SN74 S00N
IC16	: SN74LS00N
IC17	: FS7805L or MC78L05CP

D1~36 39,40,42~46 48~54	: DS442X
D38	: 1N60
D41.47	: 1S1544A

SCHEMATIC DIAGRAM

A TRIG SWITCH UNIT (X77-1110-00)

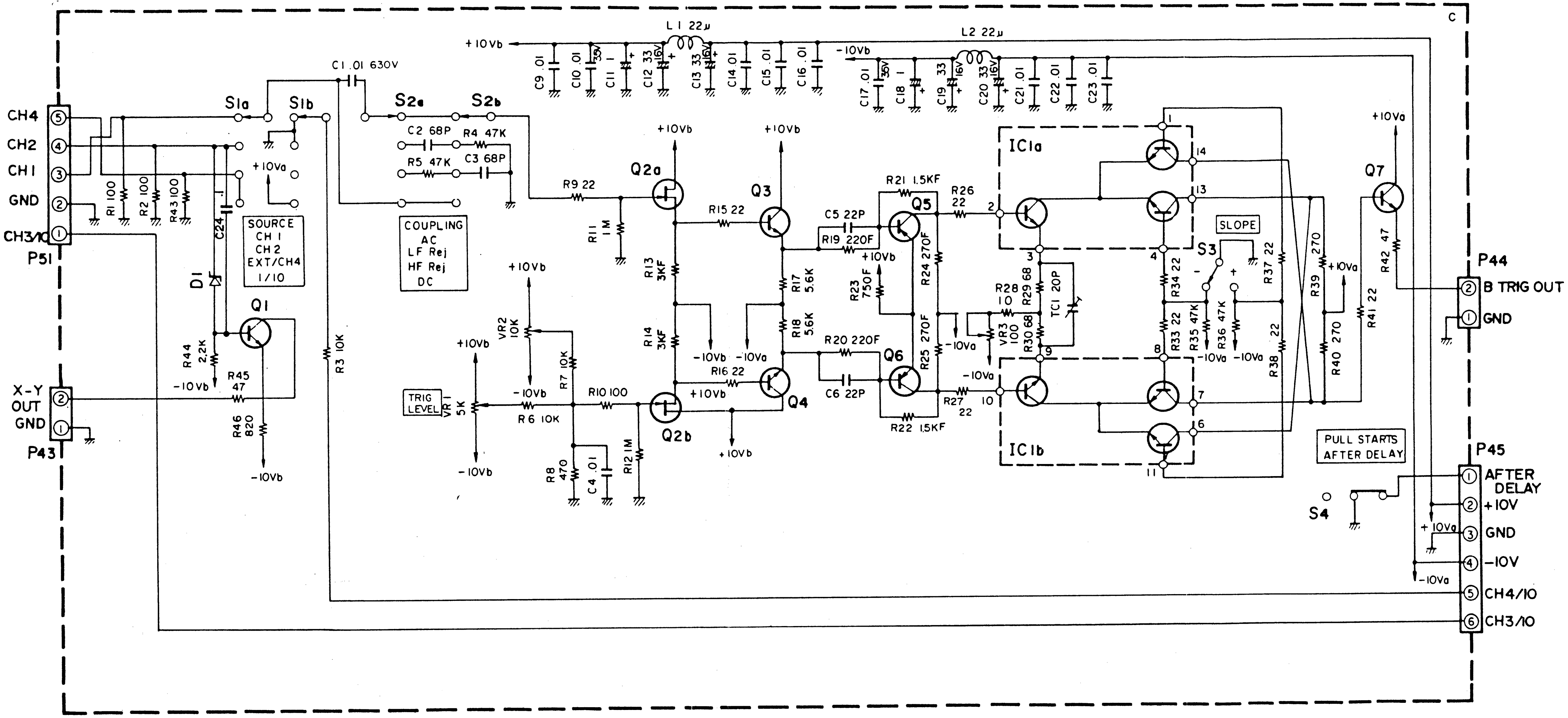

P15
CH4
GND
V. MODE
GND
CH1
GND
CH2
GND
CH3
GND
P51
CH4
CH2
CH1
GND
CH3/10
SOURCE
V MODE
CH1
CH2
EXT/CH3
1/10
COUPLING
AC
LF Rej
HF Rej
DC
VIDEO
S1a
S1b
+10V
S2a
S2b
S2c
S2d
S3a
S3b
PULL
FIX
TRIG
LEVEL
R1 51
R2 100
R3 100
R4 51
R5 100
R6 10K
C1 .01 630V
C2 68P
R7 47K
R8 47K
C3 68P
C7 3.3 50V
R59 24K
R18 10K
R17 12K
R60 36K
R19 10K
D1
Q3
C8 .01
Q4
R20 47K
R21 22K
R23 100
R25 1M
R22 22
R24 1M
R15 470
C6 .01
Q5b
Q5a
R28 22
R29 22
R26 3KF
R27 3KF
Q6
Q7
R30 5.6K
R31 5.6K
C9 22F
R32 220F
R36 750F
R33 220F
C10 22P
VR4 1K
Q8
Q9
R34 1.5KF
R35 1KF
R37 270F
R38 270F
R39 22
R40 22
D2
D3
D4
D5
D6
VR3 100
R42 68
R43 68
TC1 20P
IC1a
IC1b
R46 22
R47 22
R48 47K
R49 47K
S4
SLOPE
C31
C30 .01
R50 22
R51 22
R52 270
R53 270
R54 1K
C13 22P
R55 22
R56 47
Q10
D7
D8
D9
D10
P46
A TRIG OUT
GND
Q1
Q2
R58 10K
R9 47KF
C4 10 25V
R10 100KF
R11 100KF
R12 47KF
C5 10 25V
VR1 5K
R13 10K
R14 10K
VR2 10K
L1 22μ
C14 .01
C15 1 35V
C16 33 16V
C17 33 16V
C18 .01
C19 .01
C20 .01
C21 .01
-10V
+10V
L2 22μ
C22 .01
C23 1 35V
C24 33 16V
C25 33 16V
C26 .01
C27 .01
C28 .01
P47
+10V
GND
-10V
VIDEO
D

IC1 :CA3102E
Q1 :2SJ43(Q)
Q3,4 :2SC536KNP(F)
Q5 :DN1901
Q6,7 :2SC1215(T or S)
Q8,9 :2SA1161
Q2 :2SK127(Q)
Q10 :2SC2499

D1~10 :DS442X

SCHEMATIC DIAGRAM

B TRIG SWITCH UNIT (X77-1120-00)



C
CH4
CH2
CH1
GND
CH3/10
P51
X-Y OUT
GND
P43
S1a
S1b
S2a
S2b
C1 .01 630V
C2 68P
R4 47K
R5 47K
C3 68P
SOURCE
CH 1
CH 2
EXT/CH4
1/10
COUPLING
AC
LF Rej
HF Rej
DC
+10Va
+10Vb
-10Vb
-10Va
L1 22μ
L2 22μ
C9 .01
C10 .01 35V
C11 1
C12 33 16V
C13 33 16V
C14 .01
C15 .01
C16 .01
C17 .01 35V
C18 1
C19 33 16V
C20 33 16V
C21 .01
C22 .01
C23 .01
R1 100
R2 100
R43 100
C24 1
D1
Q1
R44 2.2K
R45 47
R46 820
R3 10K
R9 22
R11 1M
Q2a
Q2b
Q3
Q4
Q5
Q6
Q7
R13 3KF
R14 3KF
R15 22
R16 22
R17 5.6K
R18 5.6K
C5 22P
C6 22P
R19 220F
R20 220F
R21 1.5KF
R22 1.5KF
R23 750F
R24 270F
R25 270F
R26 22
R27 22
R28 10
R29 68
R30 68
VR3 100
TC1 20P
TRIG LEVEL
VR1 5K
VR2 10K
R6 10K
R7 10K
R8 470
C4 .01
R10 100
R12 1M
IC1a
IC1b
SLOPE
S3
R33 22
R34 22
R35 47K
R36 47K
R37 22
R38 22
R39 270
R40 270
R41 22
R42 47
P44
B TRIG OUT
GND
PULL STARTS AFTER DELAY
S4
P45
AFTER DELAY
+10V
GND
-10V
CH4/10
CH3/10

IC1 : CA3102E

Q5,6 : 2SA1161

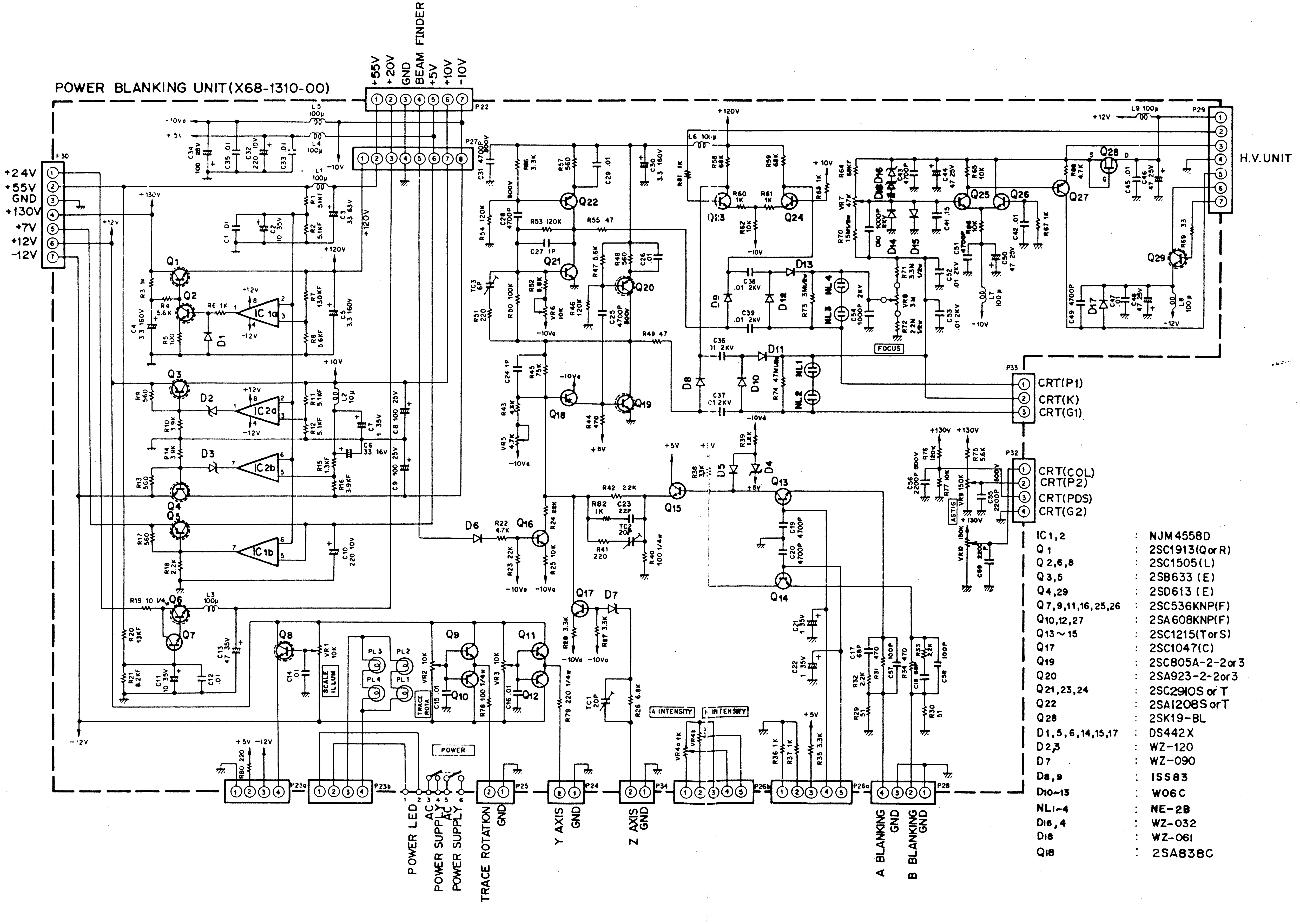
Q1,3,4 : 2SC1215TorS

D1 : WZ-081

Q2 : DN1901

Q7 : 2SC2499

SCHEMATIC DIAGRAM


POWER BLANKING UNIT(X68-1310-00)
+55V
+20V
GND
BEAM FINDER
+5V
+10V
-10V
P22
P27
P30
+24V
+55V
GND
+130V
+7V
+12V
-12V
H.V.UNIT
P29
P33
CRT(P1)
CRT(K)
CRT(G1)
P32
CRT(COL)
CRT(P2)
CRT(PDS)
CRT(G2)
FOCUS
ASTIG
IC1a
IC2a
IC2b
IC1b
SCALE ILLUM
TRACE ROTA
POWER
A INTENSITY
B INTENSITY
P23a
P23b
P25
P24
P34
P26b
P26a
P28
POWER LED
AC POWER SUPPLY
AC POWER SUPPLY
TRACE ROTATION
GND
Y AXIS
GND
Z AXIS
GND
A BLANKING
GND
B BLANKING
GND

IC1,2 : NJM4558D
Q1 : 2SC1913(Q or R)
Q2,6,8 : 2SC1505(L)
Q3,5 : 2SB633 (E)
Q4,29 : 2SD613 (E)
Q7,9,11,16,25,26 : 2SC536KNP(F)
Q10,12,27 : 2SA608KNP(F)
Q13～15 : 2SC1215(T or S)
Q17 : 2SC1047(C)
Q19 : 2SC805A-2-2 or 3
Q20 : 2SA923-2-2 or 3
Q21,23,24 : 2SC2910S or T
Q22 : 2SA1208S or T
Q28 : 2SK19-BL
D1,5,6,14,15,17 : DS442X
D2,3 : WZ-120
D7 : WZ-090
D8,9 : 1SS83
D10～13 : W06C
NL1～4 : NE-2B
D16,4 : WZ-032
D18 : WZ-061
Q18 : 2SA838C

TRIO

MANUAL CHANGE INFORMATION

Model CS-2100

Serial NO.

CHANGE

DESCRIPTION

Fig. ■ Index No.	Ref. No.	Parts No.	Name ■ Description	Serial No. Eff.	Remarks
1-13		B20-0919-14	Floating core	1070001～	Change
3-11		150ATM31A	CRT	1070001～	Change
3-12		L39-0515-05	Rotator coil	1070001～	Change
3-12		L39-0513-05	Rotator coil	1070001～	Deletion
3-3		F11-0962-22	CRT shield	1090001～	Change Note 1
3-4		F11-0967-13	CRT shield	1090001～	Change
3-13		L39-0514-15	Y align coil	1090001～	Change
		E31-0798-05	Lead wire with connector	1090001～	Change
		E31-0755-05	Leadwire with connection	1090001～	Deletion
		E31-0759-15	Wire harness	1090001～	Change
1-3		A20-2756-15	Die casting panel	1120001～	Change
1-74		W02-0402-15	High voltage block	1120001～	Change
2-15					
		K27-0524-14	Push knob	1120001～	Change
		E31-0750-15	Lead wire with connector	1120001～	Change
		E31-0751-15	Lead wire with connector	1120001～	Change
		E31-0799-15	Lead wire with connector (J57)	1120001～	Change
1-7		A22-0817-23	Sub panel	2020001～	Change
1-74		W02-0402-25	High voltage block	2020001～	Change
4-4		J21-2904-24	Bracket (For P.C. B)	2020001～	Change
4-5		J21-2905-14	Bracket (For P.C. B)	2020001～	Change
1-31		J21-2871-14	Bracket (For D.L)	2020001～	Change
1-31		J21-2928-04	Bracket (For D.L)	2020001～	Deletion
7-2		H10-2812-12	Pad (Formed styrene)	2020001～	Change
		E31-0749-15	Leadwire with connector	2020001～	Change
		E31-0751-25	Leadwire with connector	2020001～	Change
		E31-0797-15	Leadwire with connector	2020001～	Change
		E31-0790-15	Leadwire with connector (J56)	2020001～	Change
		E31-0748-15	Leadwire with connector	2020001～	Change

Note 1:
When replacing 150ATM31 with 150ATM31A, use the following parts simultaneouly.
CRT shield F11-0967-13, F11-0962-22 and Rotator coil L39-0515-05.

TRIO

MANUAL CHANGE INFORMATION

Model CS-2100 | Serial NO. 1070001 ~

CHANGE	DESCRIPTION

PARTS LIST AND SCHEMATIC CHANGE

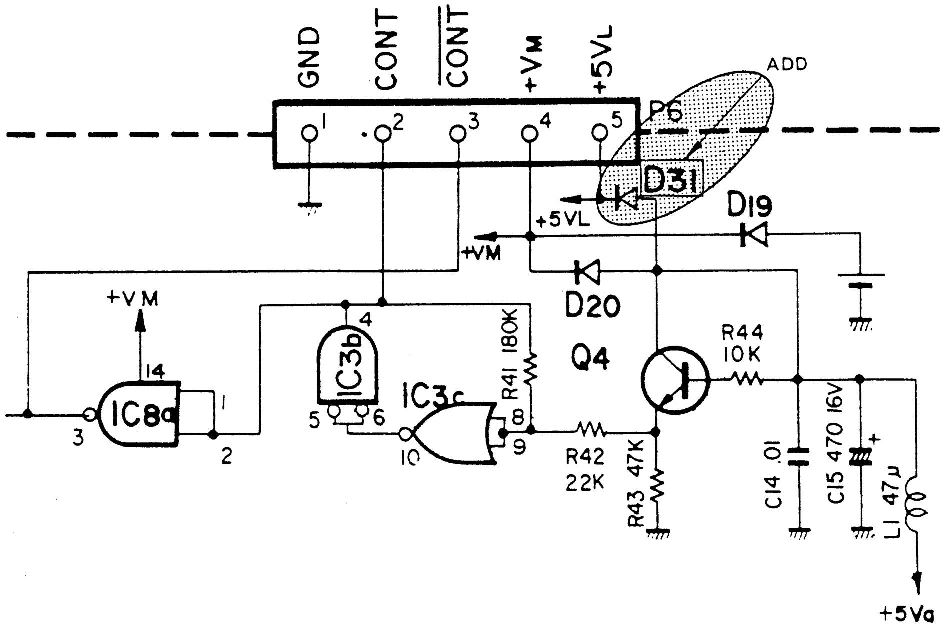
SECTION: HORIZONTAL MODEL CONTROL (X77-1130-00)

ADD:	IC17	FS7805L or MC78L05CP
	D31	DS442X

CHANGE TO:

R82	RD14BB2B560J	RD	56Ω	±5%	1/8W
R100	RD14BB2B560J	RD	56Ω	±5%	1/8W
C29	CC45CH1H390J	CC	39pF	±5%	50WV
C35	CC45CH1H390J	CC	39pF	±5%	50WV

HORIZONTAL MODE CONTROL


GND
CONT
$\overline{\text{CONT}}$
+VM
+5VL
ADD
P6
1
2
3
4
5
D31
D19
+5VL
+VM
D20
+VM
14
IC8a
1
3
2
4
IC3b
5
6
IC3c
10
8
9
R41 180K
Q4
R44 10K
R42 22K
R43 47K
C14 .01
C15 470 16V
L1 47μ
+5Va

TRIO	MANUAL CHANGE INFORMATION	
	Model CS-2100	Serial NO. 1090001 ~
CHANGE	DESCRIPTION	

PARTS LIST AND CHANGE

SECTION: MAIN CHASSIS

ADD:

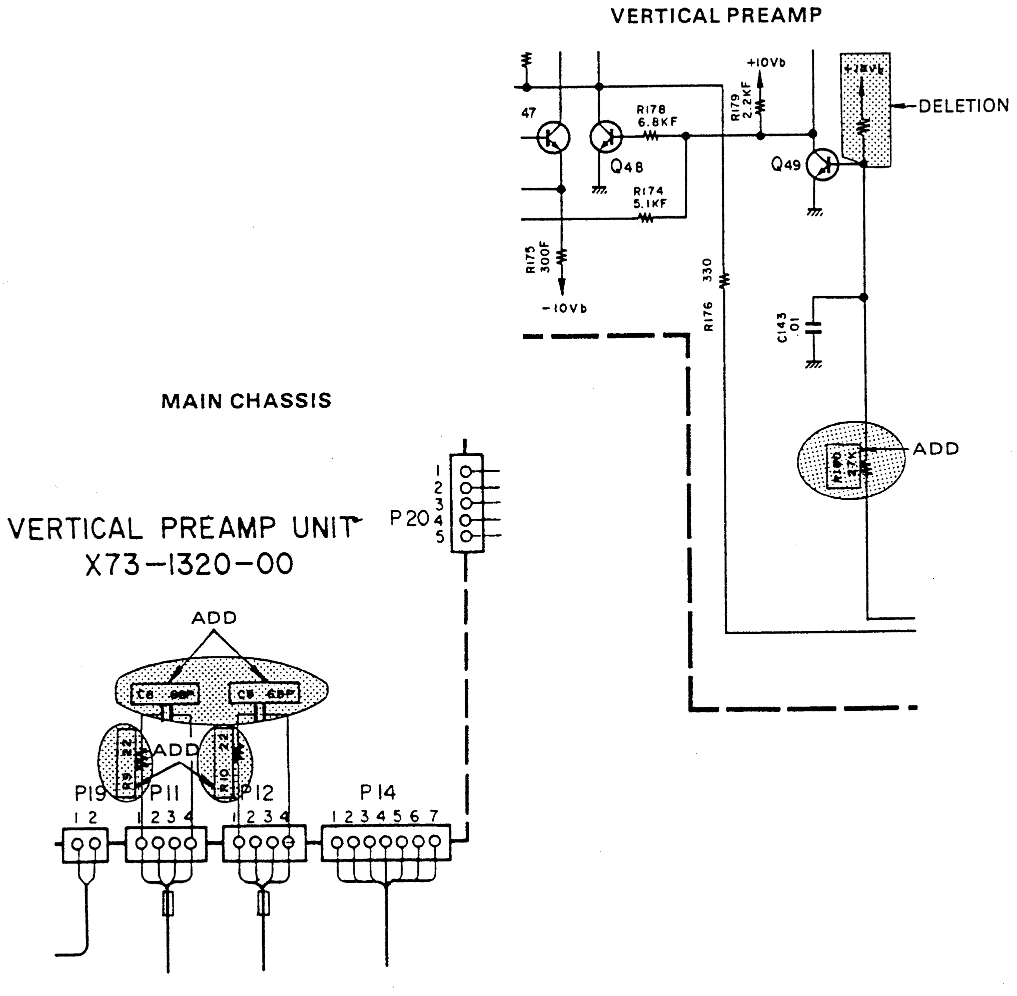
R9	RD14BB2B220J	Carbon res.	22Ω	±5%	1/8W
R10	RD14BB2B220J	Carbon res.	22Ω	±5%	1/8W
C8	CC45CH1H680J	Ceramic cap.	68pF	±5%	50WV
C9	CC45CH1H680J	Ceramic cap	68pF	±5%	50WV

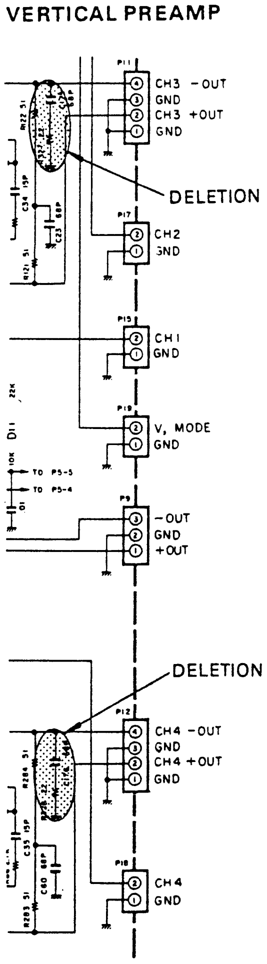
SECTION: VERTICAL PREAMP UNIT (X73-1320-00)

CHANGE TO:

R327	No use
R328	No use
C175	No use
C176	No use

SCHEMATIC CHANGE


VERTICAL PREAMP
+10Vb
47
R178 6.8KF
R179 2.2KF
DELETION
Q48
Q49
R174 5.1KF
R175 300F
-10Vb
R176 330
C143 .01
ADD
R190 27K
MAIN CHASSIS
VERTICAL PREAMP UNIT X73-1320-00
P20
1 2 3 4 5
ADD
C8 68P
C9 68P
R9 22
R10 22
ADD
P19
P11
P12
P14
1 2
1 2 3 4
1 2 3 4
1 2 3 4 5 6 7


VERTICAL PREAMP
P11
CH3 -OUT
GND
CH3 +OUT
GND
DELETION
P17
CH2
GND
P15
CH1
GND
P18
V, MODE
GND
TO P5-5
TO P5-4
P9
-OUT
GND
+OUT
DELETION
P12
CH4 -OUT
GND
CH4 +OUT
GND
P16
CH4
GND

TRIO

MANUAL CHANGE INFORMATION

Model CS-2100

Serial NO. 1120001∼

CHANGE	DESCRIPTION

PARTS LIST CHANGE

SECTION: HORIZONTAL MODE CONTROL (X77-1130-00)

ADD:

R120	RD14BB2B563J	RD	56 kΩ	±5%	1/8W
TC7	C05-0030-15	TC	20pF	(CH3 1/10 overshoot adj.)	
VR5	R12-0532-05	VR	100ΩB	(CH4 1/10 overshoot adj.)	

CHANGE TO:

R100	No use

SECTION: VERTICAL PREAMP UNIT (X73-1320-00)

CHANGE TO:

R118	RN14BK2B1800F	RN	180Ω	±1%	1/8W
R280	RN14BK2B1800F	RN	180Ω	±1%	1/8W
C19	CC45CH1H150J	CC	15pF	±5%	50WV
C56	CC45CH1H150J	CC	15pF	±5%	50WV

SECTION: VERTICAL ATTENUATOR (X75-1120-00)

ADD:

R141	RD14BB2B824J	RD	820kΩ	±5%	1/8W

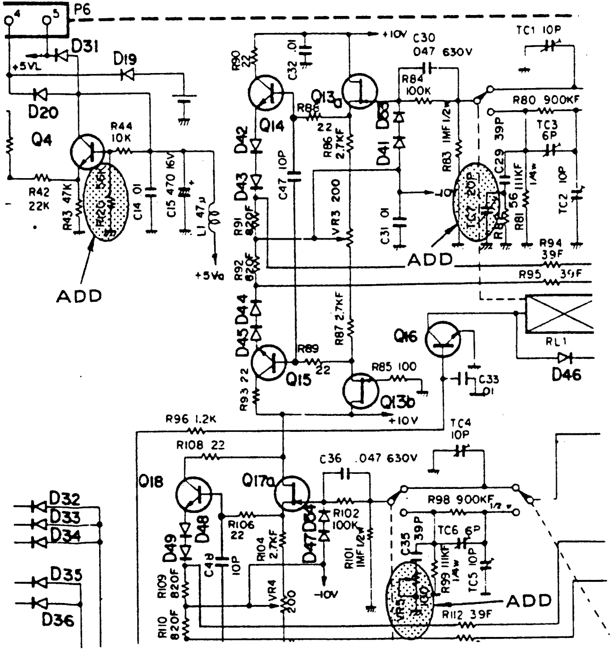
SECTION: TRIG SWEEP UNIT (X74-1220-00)

CHANGE TO:

C11	CC45CH1H150J	CC	15pF	±5%	50WV

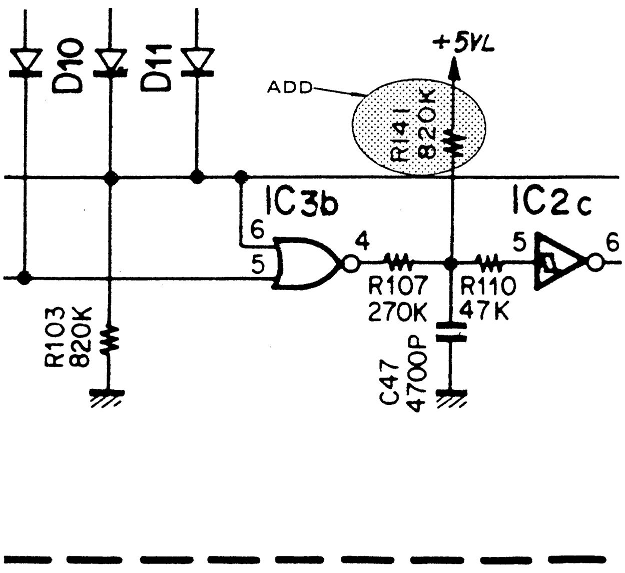
SCHEMATIC CHANGE

HORIZONTAL MODE CONTROL



+VM
+5VL
P6
D31
D19
D20
Q4
R44 10K
R42 22K
R43 47K
R120 56K
C14 .01
C15 470 16V
L1 47μ
+5Va
ADD
R90 22
C32 .01
+10V
C30 .047 630V
TC1 10P
Q14
Q13a
R84 100K
R80 900KF
D42
R86 22
R86 2.7KF
D41
D3
R83 1MF 1/2
C29 39P
TC3 6P
D43
C47 10P
VR3 200
C31 .01
TC7 20P
R81 111KF
TC2 10P
R91 820F
R92 820F
R94 39F
R95 39F
ADD
D44
D45
R87 2.7KF
Q16
RL1
D46
R89 22
Q15
R93 22
R85 100
C33 .01
Q13b
+10V
R96 1.2K
R108 22
TC4 10P
C36 .047 630V
Q18
Q17a
R98 900KF
D32
D33
D34
D35
D36
D49
D48
R106 22
D47
R102 100K
R101 1MF 1/2W
C35 39P
TC6 6P
R99 111KF
TC5 10P
R109 820F
C4 10P
R104 2.7KF
VR4 200
-10V
VR5 100
R110 820F
R112 39F
ADD

VERTICAL ATTENUATOR



D10
D11
+5VL
ADD
R141 820K
IC3b
6
5
4
IC2c
5
6
R107 270K
R110 47K
R103 820K
C47 4700P

TRIO

MANUAL CHANGE INFORMATION

Model CS-2100 **Serial NO.** 2010001 ~

CHANGE **DESCRIPTION**

PARTS LIST CHANGE

SECTION: MAIN CHASSIS

ADD:

C10	C91-0551-05	Metalized film cap	0.22 μF	630WV	

CHANGE TO:

C4	CK45E3D472P	Ceramic cap	4700 pF	+100% −0%	2000 WV
C5	CK45E3D472P	Ceramic cap	4700 pF	+100% −0%	2000 WV
	W02-0405-15	Switching power block			

SECTION: VERTICAL ATTENUATOR UNIT (X75-1120-00)

ADD:

R200	RD14BB2B470J	RD	47Ω	±5%	1/8W
R201	RD14BB2B470J	RD	47Ω	±5%	1/8W

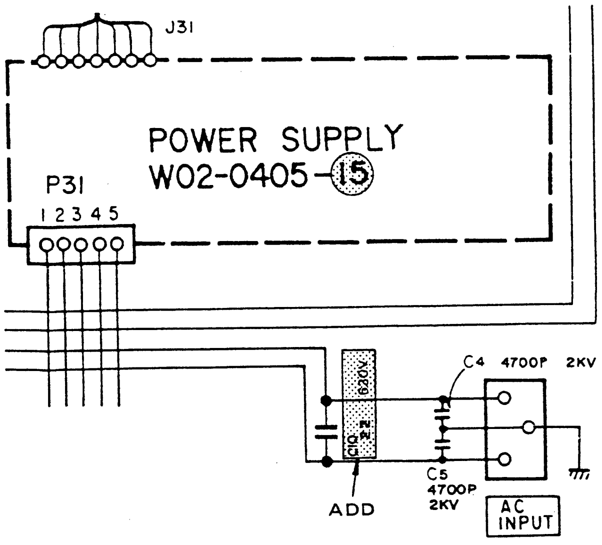
SECTION: TRIG SWEEP UNIT (X74-1220-00)

CHANGE TO:

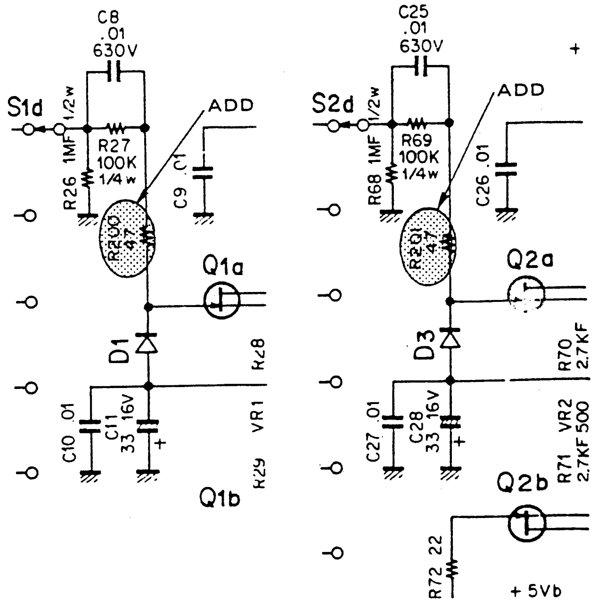
R194	RD14BB2B912J	RD	9.1 kΩ	±5%	1/8W

SCHEMATIC CHANGE

MAIN CHASSIS


J31
POWER SUPPLY
W02-0405-15
P31
1 2 3 4 5
C4 4700P 2KV
C10 .22 630V
ADD
C5 4700P 2KV
AC INPUT

VERTICAL ATTENUATOR


C8 .01 630V
S1d
1/2w
R27 100K 1/4w
R26 1MF
ADD
C9 .01
R200 47
Q1a
D1
R28
C10 .01
C11 33 16V
VR1
R29
Q1b
C25 .01 630V
S2d
1/2w
R69 100K 1/4w
R68 1MF
ADD
C26 .01
R201 47
Q2a
D3
R70 2.7KF
C27 .01
C28 33 16V
VR2 500
R71 2.7KF
Q2b
R72 22
+5Vb
+

TRIO

MANUAL CHANGE INFORMATION

Model CS-2100

Serial NO. 2020001 ~

CHANGE	DESCRIPTION

PARTS LIST CHANGE

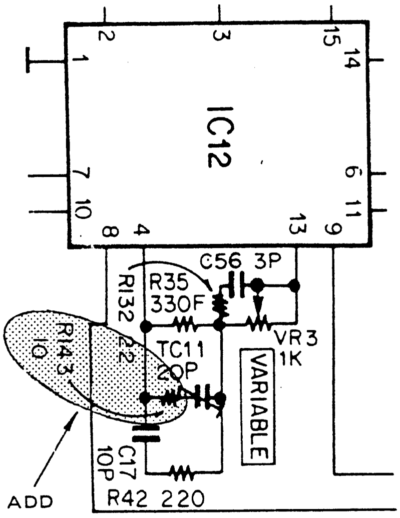
SECTION: VERTICAL ATTENUATOR UNIT (X75-1120-00)

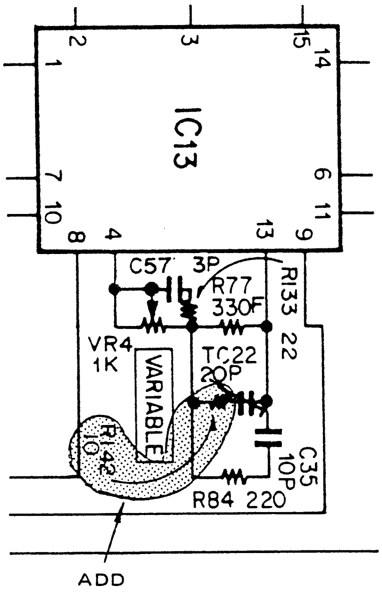
ADD:

R142	RD14BB2B100J	RD	10Ω	±5%	1/8W
R143	RD14BB2B100J	RD	10Ω	±5%	1/8W

SCHEMATIC CHANGE

VERTICAL ATTENUATOR


IC12
1
2
3
15
14
7
6
10
11
8
4
13
9
C56 3P
R35
330F
RI32
22
RI43
10
TC11
20P
VR3
1K
VARIABLE
C17
10P
R42 220
ADD


IC13
1
2
3
15
14
7
6
10
11
8
4
13
9
C57 3P
R77
330F
RI33
22
VR4
1K
VARIABLE
TC22
20P
RI42
10
C35
10P
R84 220
ADD

PARTS LIST

Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff.	
3-1		E01-1404-05	CRT socket		
3-2		E31-0564-05	Leadwire with connector		
3-3		F11-0962-12	CRT shield		
3-4		F11-0967-03	CRT shield		
3-5		F11-0968-04	CRT shield		
3-6		G16-0602-04	Reflector sheet		
3-7		G16-0603-04	Reflector sheet		
3-8		J19-1623-04	CRT band		
3-9		J21-2925-03	Bracket (For CRT)		
3-10		J21-2926-03	Bracket (For CRT)		
3-11			CRT 150ATM31		
3-12		L39-0513-05	Rotator coil		
3-13		L39-0514-05	Y align coil		
3-14		N15-1040-46	Lockwasher		
3-15		N16-0030-46	Lockwasher		
3-16		N30-3035-46	Pan-head screw 3 × 35		
3-17		N30-4008-46	Pan-head screw M4 × 8		
3-18		N89-3006-46	Screw (Tapping) 3 × 6		
3-19		N89-3010-41	Screw (Tapping) 3 × 10		

DISASSEMBLY / PARTS LIST 6

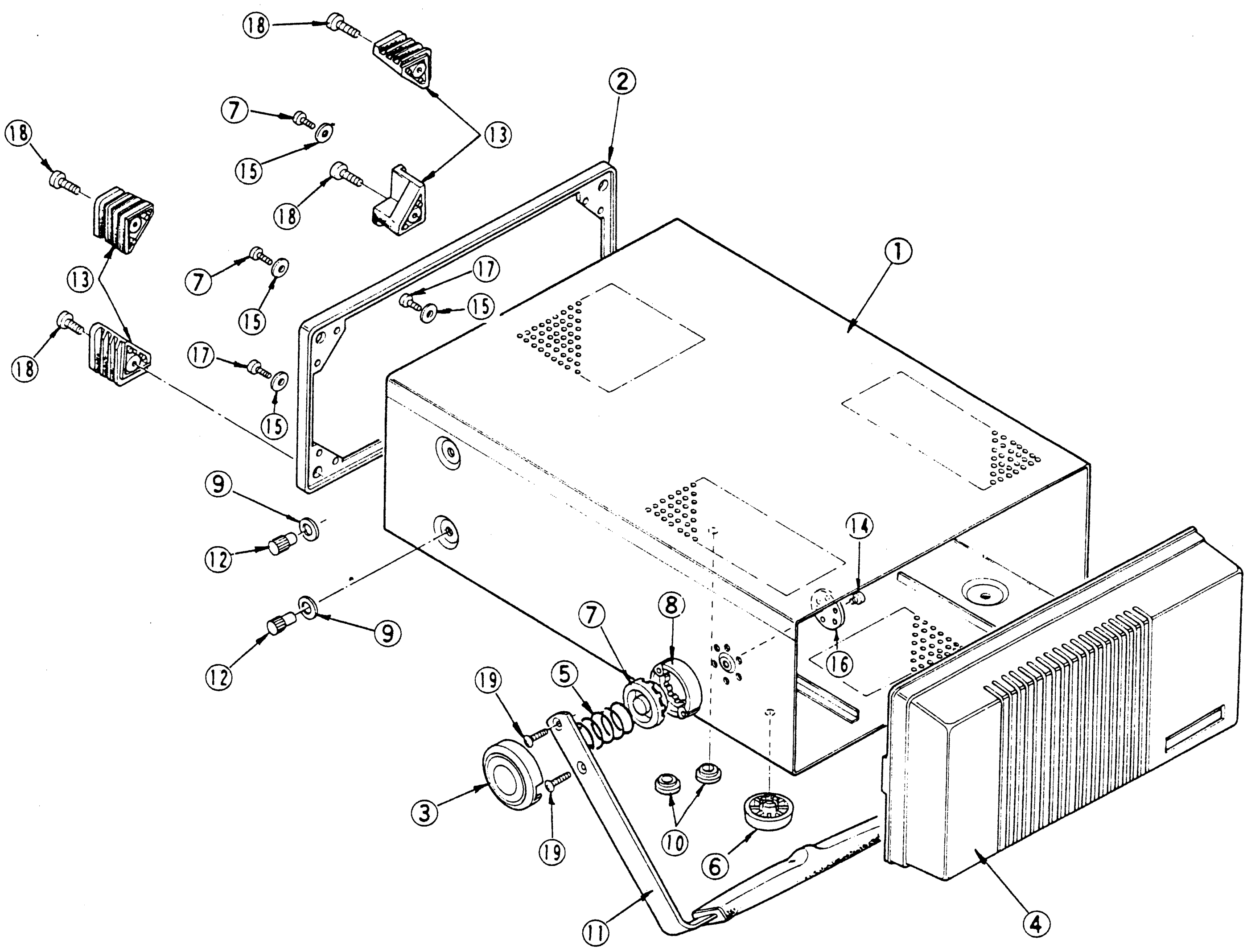


Fig. & Index No.	Ref. No.	Parts No.	Name & Description	Serial No. Eff.	
6-1		A01-0872-12	Case		
6-2		B07-0710-02	Rear escutcheon		
6-3		F07-0908-14	Handle cover		
6-4		F07-0918-02	Panel cover		
6-5		G02-0606-14	Spring (For handle)		
6-6		J02-0507-05	Rubber leg		
6-7		J21-2906-05	Gear		
6-8		J21-2907-05	Ring		
6-9		J39-0505-04	Spacer		
6-10		J42-0038-04	Bushing		
6-11		K01-0512-05	Handle		
6-12		K23-0802-14	Knob	....	*Note:
6-13		W01-0503-04	Cord wrap		
6-14		N09-0705-05	Hex socket Flat-head screw		
6-15		N17-1030-41	Lockwasher		
6-16		N19-0710-05	Washer		
6-17		N30-3008-41	Pan-head screw M3 × 8		
6-18		N30-4018-41	Pan-head screw M4 × 18		
6-19		N30-3008-41	Flat-head screw M3 × 8		

Note: When replacing R01-0512-05 with R01-0512-15, use the knob (K23-0802-14) simultaneously.